SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B, PHYSICS.

THE annual meeting of Section B, Physics, of the American Association for the Advancement of Science, in affiliation with the American Physical Society, was held in St. Louis, from December 28 to 31. The sessions were universally pronounced successful and enjoyable. The attendance varied from forty to seventy-five, and was representative of the middle west, while there was also present a number of the prominent members from the east, and a few from the Pacific coast.

The retiring vice-president, Professor E. F. Nichols, of Columbia University, was unable to be present. The section passed a resolution expressing its disappointment in not having the opportunity of listening to the expected vice-presidential address.

The presiding officers were Professor E. H. Hall, of Harvard University, vice-president of Section B, and Professor A. G. Webster, of Clark University, president of the American Physical Society. The other officers of the section who were in attendance were Dayton C. Miller, secretary; D. B. Brace, councilor, and the following members of the sectional committee—E. H. Hall, D. C. Miller, Ernest Merritt, D. B. Brace, A. G. Webster and F. E. Nipher.

For the next meeting to be held in Philadelphia, from December 28 to 31, 1904, the vice-president is Professor W. F. Magie, of Princeton University. The other officers for the Philadelphia meeting, so far as now determined, are: retiring vice-presi-

dent, E. H. Hall; secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio; members of the sectional committee, E. H. Hall, W. F. Magie, D. C. Miller, D. B. Brace, A. G. Webster, G. F. Hull and F. E. Nipher.

Professor E. Rutherford, of McGill University, gave a popular scientific lecture on 'Radium and Radio-activity.' The lecture was illustrated with many experiments and demonstrations, some exhibiting Professor Rutherford's recent researches. The lecture was greatly appreciated by the large audience in attendance.

The number of papers read at St. Louis was thirty-six, twenty-four before Section B, and twelve before the Physical Society. Of these papers thirteen were upon electrical subjects, eleven were optical, four were upon heat, three upon radio-activity and five were upon miscellaneous subjects. The abstracts of the papers read before Section B are given below; the papers given before the Physical Society are described in the report of that society.

Report of the Committee on the Velocity of Light: D. B. Brace, University of Nebraska.

A Half-Shade Elliptical Polarizer and Compensator: D. B. Brace, University of Nebraska.

To be published in full in the *Physical Review*.

On the Effect of a Magnetic Field on the Interference of Natural Light: John Mills, University of Nebraska.

The conception of natural light as an elliptical vibration and our knowledge of the Faraday 'effect' would give as a criterion for an analogous rotation of natural light, the disappearance of interference fringes, previously observable, upon the formation of a magnetic field capable of rotating plane polarized light through an angle of an odd multiple of 90°. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. Natural monochromatic light was used and the current varied. Observations were taken at the points of disappearance and reappearance of the fringes. The mean of these current readings was taken as that for which interference was impossible. These values of the current would have produced in plane polarized light a rotation of 95.8°, 256.8°, 447.5°, 613.6°.

The apparent invalidation of the results obtained because of a partial polarization of the entering light by the reflecting surfaces is also discussed.

On the Velocity of Light in a Magnetic Field: John Mills.

The experimenter undertook to measure the acceleration or the retardation experienced by a circular component traversing a magnetic field. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. The light passed through a Nicol prism and a Bravais double plate. Half of the fringes were thus composed of light circularly polarized in a direction opposite to those of the other half. The formation of a magnetic field produced a shifting of the two sets in opposite directions. The current causing a shifting of one full band (corresponding to a difference in phase of 360°) was observed. On the assumption that the rotation of plane polarized light is the result of a difference of phase between its circular components, produced by an acceleration of one component and a corresponding retardation of the other, the difference of phase corresponding to this value of the current was calculated. It was 368°. The readings for the current

giving a displacement of three bands (that is, a difference in phase of 1080°) corresponded to a difference of 1101° calculated.

Hertzian Waves since Hertz: A. D. COLE, Ohio State University.

Hertz's experimental proof of the existence of electromagnetic radiation in 1888 was the culmination of Maxwell's work and led to a large output of new research. In this Germany took the lead. Arons, Lecher, Boltzmann and Zehnder introduced better methods of showing the electrical waves. The coherer came in 1895, although its principle was discovered by Branly in 1891. Three of the new receivers were strictly quantitative; the electrometer of Bjerknes, the oscillation-bolometer of Paalzow and Rubens and the thermo-receiver of Klemenčič. Important improvements in the exciter were made by Righi in 1893 and by Blondlot. J. J. Thomson and Lecher used the Hertzian oscillations to measure dielectric constants. Rubens and Arons showed that the Maxwellian relation between these and the refractive index held better with Hertzian than with light waves. Cohn extended this to the case of water. This was shown to be rigidly true by Drude, by Cole and by Cohn and Zeeman. Cole showed that alcohol possesses anomalous dispersion for electrical waves. Drude and Lampa proved this true of many substances. Drude perfected apparatus for determining refractive indices. Lecher and also Larasin and de la Rive showed that the velocity along wires is the same as in air. Blondlot, Trowbridge and Duane, and Saunders gave more exact proofs that this velocity was that of light. The gap between the wave-lengths of electrical and light waves has been narrowed from each side. Lebedew reduced the former to 1 mm., Dubois and Rubens produced longer infra-red waves.

The essentials of the electromagnetic theory have been established. It remains to correlate with it our views of corpuscles and the Becquerel rays.

A Simple Alternate Current Frequency Recorder: E. S. JOHONNOTT, Rose Polytechnic Institute.

The instrument may be attached directly to alternating current mains and a record of the frequency obtained. To one pole of the electromagnet of an ordinary electric bell is attached a light armature which is held at some little distance from the other pole by a stiff flat spring. If now an alternating current is sent through the coils the armature vibrates, ordinarily, with a frequency equal to twice that of the current. If a stylus be arranged on the outer end of the armature to leave a trace on a smoked drum alongside that of a seconds pendulum or an electromagnetic tuning fork the frequency may be counted off at once. The current through two incandescent lamps in parallel in 100 volts is sufficient to give ample motion.

Iron Losses in Loaded Transformers: E. S. JOHONNOTT, Rose Polytechnic Institute.

With the addition of a differential coil to the Rayleigh phasemeter it was adapted to measure directly the loss of energy in the iron of a loaded transformer. The readings give at once also the magnitude of the exciting current and its phase with respect to the induction. A transformer of special design to test the effect of magnetic leakage was used in the experiments. The conclusions drawn from the work were as follows: (1) In a transformer having great magnetic leakage between the primary and secondary, and in which a constant induced E.M.F. is maintained and measured. (*a*) In the secondary. There is an apparent increase in values of the loss of energy in the iron, the magnitude of the exciting current and the cosine of the angle

of lag between this current and the induced E.M.F. as the load in the secondary is increased. (*b*) In the primary. There is an apparent decrease in the loss of energy in the iron, the magnitude of the exciting current and the cosine of the angle between, as the load increases. (2) If the load is increased in the secondary of a transformer in which there is little magnetic leakage, not only the loss of energy in the iron, but the exciting current and its phase with respect to the induction remain constant.

A Method for the Determination of Mutual Induction Coefficients: Augustus Trowbridge, University of Wisconsin.

The method is based on the fact that when a pair of coils are joined in series so that the magnetic tubes of force form one thread through the other in the same direction as those due to it the self-inductance of the pair is $L_1 + 2M + L_2$. When the current is reversed through the one coil but not through the other the coefficient of self induction of the pair is $L_1 - 2M + L_2$.

By a bridge method each of these quantities may be determined in terms of a standard self inductance and thus M (the coefficient of mutual induction) is obtained. A careful comparison of the results obtainable with this method with those by other known methods seems to be considerably in favor of this method, the probable error being about 1 part in 800.

The Influence of Occluded Hydrogen on the Electrical Resistance of Palladium: W. E. McElfresh, Williams College.

To be published in full in the *Transactions of the American Academy of Arts and Sciences.*

On Hydrogen-charged Palladium: E. H. Hall, Harvard University.

This paper is a review of the main facts known in regard to the properties of hydrogen-charged palladium and an examination of the various suggestions which have been made as to the nature of the union between the two elements concerned. The point is made that previous estimates, by Graham and by Troost and Hautefeuille, of the density of the hydrogen in the combination gave values very much greater than the observed value of liquified hydrogen. These estimates practically neglected the possibility of spaces between molecules of palladium sufficiently large to admit molecules of hydrogen with little expansion of the solid. The evidence in favor of a definite chemical combination between the palladium and the absorbed hydrogen is, on the whole, inadequate.

A New Form of Frequency Meter, Preliminary Note: A. S. Langsdorf, Washington University.

The paper described a type of instrument to indicate frequency on alternating-current circuits, the readings to be independent of fluctuations of voltage on the line, the connections similar to those of an indicating wattmeter.

A Remarkable Distribution of Carbon on the Bulb of a 'Hylo' Incandescent Lamp: Arthur L. Foley, University of Indiana.

In the 'Hylo' turn-down incandescent lamp there are two filaments, one of 16 c. p. (*F*) and one of 1 c. p. (*f*), the former consisting of two and the latter of three turns. Whatever be the direction of the current, the filament coils are of opposite polarity.

When *f* is burning *F* is in series with it, but the current is insufficient to render the latter luminous. When *F* is burning *f* is short-circuited. Let *P* and *P'* be points on the globe at the ends of a diameter through the plane of the filaments, and *NS* and *sn* be points on the globe where

the axes of the filaments *F* and *f* meet it. At *P* there is a deposit from one to two centimeters wide, while the globe is perfectly clear on either side. At *P'* the conditions are exactly reversed, the central region being dark with clear glass on each side. At *n*, also at *s*, there is a small circular deposit about half the area of a turn of *f*. This deposit is surrounded by another in the form of a ring about one centimeter wide and two centimeters in diameter, the ring being open next to the base of the lamp. Between the central deposit and the ring the glass is clear. There is no deposit within two centimeters of the base of the lamp, and very little on the crown. The theory of molecular shadows and the Edison effect, so thoroughly worked out by Fleming* and others, explains the general character of the deposit, but seems to fail to explain the definiteness of it. In general the deposit is of uniform density and quite dark, while the clear places are perfectly clear, the line of separation being as definite as if the deposit had been laid on with a brush. The weak magnetic field of the small filament was sufficient to concentrate the deposit at the ends of its axes, leaving certain regions perfectly clear. It seems that it should be possible to keep clear any desired part of the wall of a vacuum table. The peculiarity of the deposit above described was noticed but a few weeks since, hence the incompleteness of this investigation. An attempt to age a number of similar lamps by running at an excessive voltage resulted in a practically uniform deposit.

On the Charges given to Surfaces by the Diffusion of Ions, and the Earth's Negative Potential: JOHN ZELENY, University of Minnesota.

Experiments are described showing that neutral ionized air in passing through a long tube at first gives a negative charge to the walls, but as it passes along it eventually gives them a positive charge. In passing through a short tube the ionized air acquires a positive charge, while the tube itself becomes charged negatively. Similar effects were obtained with dry carbonic acid, but when the gas was saturated with water vapor the effects were all reversed in sign. The experiments are all explained by supposing the charges to arise from the unequal rates of diffusion of the two ions. It is shown that Villari's hypothesis that charges are given to metals by the friction of the ionized gas against the metal does not suffice to explain all of the facts. Simpson's objection to Geitel's explanation of the earth's negative potential is next taken up and the results of the above experiments are used in refutation of the objection. Other theories of the cause of the earth's negative potential are briefly considered.

The Rate of Propagation of Smell: JOHN ZELENY, University of Minnesota.

The propagation of smell through tubes where the air is free from convection currents was found to be very slow, as has already been noted by Ayrton; showing that the fast propagation ordinarily observed in free space is due almost entirely to convection currents. For example, with ammonia diffusing through a tube a meter and a half long, over two hours elapsed before the smell could be detected at the other end of the tube. Using different lengths of tubing, it was found that the time required for the diffusion of the smell was roughly proportioned to the square of the length. Ammonia and hydrogen sulphide were used for the above experiments. The presence of ammonia could be detected chemically at a point in a tube after about

* 'Molecular Shadows in Incandescent Lamps,' *Philosophical Magazine*, Vol. 20, 1885. 'A Further Examination of the Edison Effect in Glow Lamps,' *Philosophical Magazine*, Vol. 42, 1896.

the same time as when the sense of smell was used for a detector. The rate of propagation of the smell of ammonia was not markedly different when this had to pass along the same tube either horizontally or vertically upward or vertically downward. With camphor, however, while the rates horizontally and downward were about the same, the speed upward was about twice as great. The smell given to iron and brass by rubbing these with the fingers was also tried, but gave no definite results.

On the Theory of the Electrolytic Rectifier: S. R. Cook, Case School of Applied Science.

When aluminum is the anode in an electrolytic cell in which oxygen is set free there is very quickly introduced into the cell an exceedingly high apparent resistance. If aluminum is made the kathode and carbon or platinum the anode, the resistance is normal and very low. The anomalous action of this cell was noted by Professor Tait in 1869, but the cell did not attract attention until 1897, when Pollok and Grätz showed that the cell could be used to rectify an alternating current. Since 1897 investigations on the electrolytic rectifier have been published by Wilson and Norden, Burgess and Hambuecher, Taylor and Ingals, and Dr. Guthe. Each investigator set forth an independent theory for the high resistance of the aluminum anode. The object of this investigation was to determine the cause of this anomalous action of the aluminum anode, and it was found by a series of measurements of the applied electromotive force and the current, and also of the counter electromotive force with the same current; that the very high apparent resistance could be accounted for on the theory that it was due to the counter electromotive force. The potentials were measured by methods that were independent of the resistance, and curves were plotted showing the direct and counter electromotive force with current. When the electromotive force is greater than a certain critical value depending on the temperature the high resistance breaks down. This was shown to be due to the crystallization of the film around the aluminum anode, which exposed free metallic surfaces to the ions. It was also shown by direct determinations that free metallic aluminum conducted as readily when anode as when kathode, and the counter electromotive force was due to charged ions that could not penetrate the film formed on the aluminum.

On the Position of Aluminum in the Voltaic Series and the Use of Aluminum as a Positive Element in a Primary Cell: S. R. Cook, Case School of Applied Science.

Wheatstone in 1855, while determining the position of aluminum in the voltaic series, found that when immersed in a dilute solution of potassium hydroxide aluminum was negative to zinc and positive to cadmium, tin, lead, copper, iron and platinum; and in a solution of dilute hydrochloric acid aluminum was negative to zinc and positive to other elements. The object of the research was to make quantitative measurements on the difference of potential between aluminum and the other elements in different solutions. Measurements were made in several alkaline solutions, three acids and several salts. It was found that the difference of potential did not remain constant, but, in general, any solution the negative ions of which would attack the aluminum producing a soluble compound, the potential was more constant than in those solutions in which oxygen was the negative ion forming with the aluminum an insoluble compound. Measurements were taken with zinc, cadmium, tin, lead, copper, iron and platinum in solu-

tions of potassium hydroxide, hydrochloric, nitric and sulphuric acid, and ammonium chloride, potassium chloride, aluminum and potassium sulphate. A primary cell composed of aluminum, potassium sulphate, aluminum and carbon, was also investigated. The peculiarity of this cell was that it gradually increased to a maximum and again fell to its normal value when disturbed. It was also shown that the amount of current that could be taken from the cell was very small, and that the temperature coefficient was positive.

On the Differential Telephone: WILLIAM DUANE, University of Colorado.

Two separate coils are wound on the bobbin of a telephone receiver, and by suitable means are adjusted so as to have equal resistance, and equal self-inductances, and so that the magnetizing effect of a current flowing through one coil would be annulled by that of an equal current flowing in the proper direction through the other coil. To measure a self-inductance the unknown coil X and a variable self-inductance standard S are placed in series with the two receiver coils respectively, and a non-inductive resistance box R is inserted in series with S or X, according as the resistance of X is greater or less than that of S. The two entire circuits are joined in parallel, and an alternating E.M.F. is applied to the branch points. Values for R and S can be found easily, such that no sound is heard in the receiver, and, when this is the case, the self-inductance of S equals that of the unknown coil X. The magnetizing effects of the two receiver coils can be equalized by placing a small auxiliary coil in series with one of the receiver coils and with its plane parallel to the axis of the receiver. Joining the two receiver coils in series and sending an alternating current through them, a position for the auxiliary coil can be found that completely extinguishes the sound. With a receiver that will detect 10^{-6} amperes, the theoretical accuracy is about one one-hundredth per cent. Practically an accuracy of one part in five thousand is not difficult, as absolute silence can be obtained, if there is no iron in coil X. The advantages of this method of measuring self-inductance are: (a) That the apparatus is portable and does not get out of order easily; (b) that great accuracy can be obtained and the manipulation is not difficult; (c) that only one standard is required, and it is not necessary to know the value of any resistance or bridge-wire lengths. The disadvantage is that the self-inductance of the standard must *equal* that of the unknown coil. A range from zero to 150 milli-henrys can be obtained, however, with ordinary laboratory apparatus.

The Selective Reflection of Fuchsin: W. B. CARTMEL, University of Cincinnati. Presented by D. B. Brace.

This investigation was undertaken in order to ascertain whether the reflection from substances showing metallic reflection agreed with the values computed from reflection formulas. The reflection from a film of fuchsin was determined for various wave-lengths. The films of fuchsin were deposited upon a glass plate, and the reflection was measured not only from the upper surface of the fuchsin, but also from the interface between the fuchsin and the glass. The measurements were made by means of a Brace spectro-photometer. Instead of using the usual method of comparing the light reflected from the fuchsin with the light reflected from some other substance, whose coefficient of reflection was assumed to be known, the reflected light was compared with the direct light from the same source which supplied the reflected light. The work was begun last summer at the University of Nebraska and is now being continued at the University of Cincinnati.

Primitive Conditions in the Solar Nebula: Francis E. Nipher, Washington University.

The writer has used the equations developed in his paper forming No. 5, Vol. XIII., of the *Transactions of the Academy of Science of St. Louis,* for computing the numerical values throughout the primitive solar nebula. He finds that the resulting density and pressure, if the nebula be assumed a gas, filling the volume internal to Neptune's orbit, is incompatible with known physical conditions. The author concludes that the solar nebula was composed of discontinuous masses of solid matter during most of its early life. It was only in its later stages that gravitating compression caused the central mass now called the sun to fuse and vaporize.

On the Investigation of the Kinetic Theory of Gases by Elementary Methods: Henry T. Eddy, University of Minnesota.

This paper establishes some of the principal results of the kinetic theory of gases, such as the mean frequency of collision, the mean free path, the number of molecules striking a given area per second, the ratio of the specific heats, etc., on the assumption of a given constant velocity for all molecules, by simple semi-geometrical methods.

A Demonstration to disprove the Second Law of Thermodynamics: Jacob Wainwright, Chicago.

Paper published in full by the author.

At the 1902 meeting, at Pittsburg, the author presented to the members of the section a demonstration having substantially this same title. That particular demonstration was based upon a phenomenon disclosed by the published research work of Emile Hillaire Amagat, of Paris, viz., 'At or about an absolute temperature of 274°, and at pressures above the critical pressure, carbon dioxide becomes practically or absolutely incompressible or inert, as regards the influence of pressure alone.' The demonstration was confronted by the suggestion that Amagat's work should be thoroughly verified before it could be accepted as evidence to effect a so important revolution in physical and chemical science. In order to overcome such difficulty, the subject was presented in a simple manner free from all questions of quantitative analysis and unverified matter. The pressure condition of a practically perfect gas is manipulated and transformed, and all postulations, except the 'first law' of conservation of energy, which is properly a postulation in a strict sense, but has been thoroughly verified as it relates to the various phenomena which contribute to this demonstration, are dispensed with. Maxwell questioned the validity of the 'second law,' but failed in his attempts to devise a material or real cycle to effect a refutation; and as a last resource, invoked his demon and kinetic theory combination. This particular problem was solved by devising a working medium consisting of a combination of a gas and solid matter; the solid matter being arranged so as to constitute a complete heat engine in itself and having the *peculiar* property of transmuting heat into work by reason of *either* a rise or a fall in temperature. In this manner is produced a working medium which, taken as a whole, is not amenable to the 'second law.'

The Continuous Method of Steam Calorimetry: Joseph H. Hart, University of Pennsylvania.

The continuous method of steam calorimetry here outlined is capable of measuring readily latent and specific heats of fluids with a degree of accuracy seldom attained by other methods, even though they be made with the greatest refinement in the method and observations. If a stream

of water at a temperature of T_1 be passed through a worm immersed in a steam bath and energies at a temperature T_2, the quantity of heat absorbed is $mS(T_2 - T_1)$ where m is the mass of water passed through and S the mean specific heat of water between T_2 and T_1. If the heat absorbed by the water is obtained by direct condensation of steam alone we have the equation

$$ML = mS(T_2 - T_1)$$

when M is the mass of the condensed water and L the latent heat of condensation of steam. If either L or S is taken as known the other may be readily obtained. Barnes's values of S were taken and a number of determinations of L made to test the efficiency of the method. In the practical development of the method, the process was made continuous. The water in the worm and the condensed water were drawn off constantly and measured. Radiation and conduction entered as important factors in the construction of the calorimeter, but were eliminated or a least satisfactorily accounted for in the amount of condensed water by both theory and practice. Results were obtained in consecutive experiments which were concordant to the fifth significant figure. The value of L which was obtained was slightly lower than Callendar's value of 540.2 calorics at 20° C. and points to the existence of a slight constant error.

On the Thickness of Adsorbed Aqueous Films: L. J. BRIGGS AND A. W. MCCALL, United States Department of Agriculture.

Parks (*Phil. Mag.*, May, 1903) found the thickness of the aqueous film adsorbed on the surface of glass wool to be 13.6×10^{-6} cm. He also calculated the thickness of the film on silica by an indirect method based upon Martini's calorimetric measurements, and obtained the value 44×10^{-6} cm.

The authors have measured the thickness of the aqueous film on glass wool, silica and quartz when exposed at 30° C. to an atmosphere five sixths saturated. The substances were kept at constant temperature in a thermostat, and were continually stirred so as to bring the material into thorough contact with the water vapor. The amount of water taken up was determined by drying at 110° C. The surface area was calculated from microscopic measurements. The following values for the thickness of the film were obtained, based upon the assumption that the density of the adsorbed layer is the same as that of the liquid in mass.

Silica	167	$\times 10^{-6}$ cm.
Glass	18	$\times 10^{-6}$ cm.
Quartz	0.45	$\times 10^{-6}$ cm.

The great discrepancy in the results obtained for silica and quartz indicates that in the case of silica we have something analogous to a solid solution—a conclusion supported by the results of Bellati and Finazzi. It is not improbable that in the case of glass also there is something more than simple adsorption, and that the measurements with quartz give more nearly the true value of the thickness of the adsorption film.

The Circulation of the Atmosphere, as indicated by the Recent Abnormal Sky Colors: A. LAWRENCE ROTCH, Blue Hili Meteorological Observatory.

The author urges upon physicists and others in various parts of the world the importance of recording the dates when unusually brilliant sunset glows and the reddish corona around the sun, known as Bishop's rings, are visible, as has been the case intermittently during the past year. These phenomena are probably caused by discontinuous clouds of volcanic dust in

the upper atmosphere, and the author has ascertained that the analogous optical effects were observed in the eastern United States about twenty days later than in central Europe, which, assuming a movement from the west of the dust-bearing currents, indicates an approximate velocity of thirty miles an hour, or considerably less than that of the highest ice-clouds. After the Krakatoa eruption in 1883 the rate of propagation of the volcanic dust from east to west, at a height above the equator calculated from the duration of the sunset colors, was determined with considerable accuracy by a committee appointed by the Royal Society, and it is hoped that sufficient observations will now be collected to enable the velocity of the highest currents above the temperate regions to be deduced equally well.

DAYTON C. MILLER,
Secretary.

ZOOLOGY AT THE ST. LOUIS MEETING.

SECTION F of the American Association for the Advancement of Science and the Central Branch of the American Society of Zoologists met in joint sessions at the St. Louis Meeting for the reading of papers, but held separate business meetings. On Monday afternoon, December 28, the address of Vice-President Hargitt before Section F was read by Professor C. C. Nutting, in the absence of the author, the subject being 'Some Unsolved Problems of Organic Adaptation.' Section F was organized with the following officers:

Vice-President—E. L. Mark, Harvard University.

Secretary—C. Judson Herrick, Denison University.

Councilor—A. M. Bleile.

Sectional Committee—E. L. Mark, Vice-President 1904; C. W. Hargitt, Vice-President, 1903; C. Judson Herrick, Secretary, 1904–1908. For one year, H. F. Osborn; for two years, S. H. Gage; for three years, C. H. Eigenmann; for four years, H. B. Ward; for five years, Frank Smith.

Member of General Committee—Jacob Reighard.

Press Secretary—C. Judson Herrick.

Joint sessions for the reading of papers were held on Tuesday and Wednesday, at which the following communications were presented. Titles preceded by an asterisk were presented by Section F; others by the Society of Zoologists.

**The Albatross Rookeries on Laysan:* C. C. NUTTING, University of Iowa.

An exhibit of lantern slides after original photographs taken by the author during the Hawaiian cruise of the *Albatross* in May, 1902.

A Restricted Habitat of Scutigerella immaculata (Newport), together with some remarks on the Animal and its Habits: STEPHEN R. WILLIAMS, Oxford, O.

In the bed of a small branch of Four Mile Creek, a tributary of the Great Miami River, a comparatively large number of specimens of this little centipede have been found. As far as ascertained the range of this particular group of this species is limited to a part of the bed of this small branch perhaps 600 feet in length. A discussion of the surroundings in general, the precise habitat which the animals seek, some of their observed habits in captivity, and one instance of breeding in confinement, were included. Larvæ have been kept through one molt and certain bodies which may possibly be eggs have been seen.

On the Analogy between the Departure from Optimum Vital Conditions and Departure from Geographic Life Centers: CHARLES C. ADAMS, University of Michigan.

In a previous paper (*Biological Bulletin*, III., 115–131) the writer briefly discussed some of the criteria which may be used to determine geographic life centers, and certain functional and structural changes resulting from departure from such centers. At the present time attention is called to

other principles involved in radiate dispersal and the significance of these principles in the interpretation of certain ecological laws, habitats and faunal areas. There are certain well-known physiological laws which must be borne in mind. The natural starting point is the vital optimum. Departure from this optimum has a certain definite result. The new vital conditions are a cause of stimulation, and with further departure (beyond a certain limit) lead to increased stimulation or to unfavorable conditions. This results in retarded growth, development and reproduction of the organism as a whole. Thus the end results of extreme departure from the optimum in either direction are similar. In many respects a center of geographic origin is analogous to a vital optimum and any departure from such a center may result in effects similar to those brought about by a departure from the vital optimum, retarded growth, development and reproduction. The results of extreme departures from such a center are also remarkably similar. In view of these relations, many apparently isolated distributional and ecological facts may be correlated.

**A Feature in the Evolution of the Trotting Horse:* FRANCIS E. NIPHER, St. Louis, Missouri.

Twenty years ago the author published an equation representing the relation between the speed of the trotting horse and the time measured from any assumed date. The date for the origin of any speed was determined by the rate of increase in the number of horses capable of making that speed. It was, therefore, determined without any reference to the date when some individual horse broke the world's record. The author drew the curve represented by the equation published in 1882, and plotted the observed cases from 1845 to date when the record was actually broken upon the same diagram. The general agreement of these experiments with the curve is very striking. The points representing the observed speed of record-breaking horses are found to group themselves into steps corresponding to generations of the horse. Flora Temple found the horse slow on the computed speed represented by the curve. She put the horse ahead. The same is true of Dexter, of Goldsmith Maid, of Maud S. and of Nancy Hanks. The diagram shows that this evolution of speed is not a continuous operation, but that it goes on in steps or jumps. In 1892 the new sulky with ball bearings made a similar jump in the time of trotting a mile. It is very likely that this advance will also be taken up in time, and will correspond to less radical improvements made in the old sulky before 1892. A photograph of the diagram was exhibited. On the same diagram the performance of the running horse is shown from three widely separated records.

Further Observations on the Breeding Habits and on the Function of the Pearl Organs in Several Species of Eventognathi: JACOB REIGHARD, University of Michigan.

At the Washington meeting of the society the writer described the breeding habits of the horned dace, stone-roller and black-headed dace. In the breeding season the males of these forms possess hard, spine-like thickenings of the epidermis known as pearl organs. The function of these transient structures had been hitherto a matter of conjecture, but it was shown that they are used by the males of some species in their battles with one another and in building their nests, while in the males of all species the chief function of the organs was shown to be that of enabling the male to hold the female during the spawning act. In the present paper

the writer reviewed his work on the horned dace and showed instantaneous photographs of the spawning fish. He described further the breeding habits of the common shiner, in which the function of the pearl organs is essentially the same as in the horned dace. He described also the breeding habits of the back sucker. In this form the spine-like pearl organs occur in rows on the lower half of the sides of the tail and on the enlarged anal of the male. In spawning the female is held by two males, one on either side of her. The rough anals and caudals of the two males press against the sides of the body and tail of the female, and hold her in place. They also press against one another beneath and behind the female, and thus hold the two males side by side. Spawning is accomplished by a rapid vibration of the tails of the three fishes, and during the act the eggs and milt are emitted and mingled with the sand and gravel which have been stirred up.

Phototaxis in Ranatra: S. J. Holmes, University of Michigan.

Ranatra shows under ordinary circumstances a marked positive phototaxis. Individuals when in the water keep swimming vigorously for a long time in the endeavor to go towards the lightest portion of their environment. When taken out of the water *Ranatras* at first feign death. lying practically motionless for several minutes. If a strong light is moved about near them they come out of their feint much more quickly than when left entirely alone, and soon begin to follow the light with much vigor. The first responses, however, are slight and consist of a small lateral movement of the head when the light is moved from side to side. Shortly after this the animal will respond by vertical head movements as the light is moved back and forth over the long axis of the body. Moving the light around in a circle, the head responds by circular movements of a most regular and precise kind. For every position of the light there is a corresponding attitude of the head. Next following the head reflexes come the reflex movements of the respiratory tube, which becomes raised and lowered coincident with the head as the light is moved to and fro above the body. After a greater or less interval the animal rises on its legs, and if the light is now moved from side to side, the body will perform swaying movements, leaning over strongly towards the side on which the light is held. The legs on the side towards the light are strongly flexed, while those on the opposite side are held in a state of extension. If the light is passed to and fro in a longitudinal direction corresponding swaying movements are likewise performed. When the light is in front, the animal bows down; when it is moved behind, the anterior end of the body is elevated, often at an angle of forty-five degrees. Moving the light around the animal in a circle, the body follows with corresponding motions. These responses are so regular and definite that one might almost tell what particular attitude of the body, legs and head will be assumed for a given position of the light. Light in *Ranatra* apparently produces a powerful effect upon the tension of the muscles and may be made to control the behavior of the creature in a most precise and arbitrary manner.

**Studies on Protoplasmic Structure:* A. W. Greeley, Washington University, St. Louis.

The influence of chemical, electrical, thermal and osmotic stimuli upon the protoplasmic structure. The effect of these variations in structure upon the elementary vital phenomena, with special refer-

ence to the chemotropic and galvanotropic reactions.

Amitosis in the Embryo of Fasciolaria: HENRY LESLIE OSBORN, Hamline University, St. Paul, Minnesota. (Read by title.)

Very early embryos of *Fasciolaria* exhibit amitosis, a fact of interest because direct nuclear division is seldom seen in embryos. The embryos are in the gastrula stage, the various organs of the head, foot and visceral regions not yet having begun to put in an appearance. The *Fasciolaria* embryo is very peculiar in being greatly dilated by the large number of primitive ova which it has swallowed to serve as food. Each of these ova is a large mass of small yolk grains enclosed by a distinct cell wall and permeated by cytoplasm containing nuclei. The endoderm is composed of cubical cells in which one sees nuclei in all stages of direct division. In addition to the ordinary form of amitosis, one also sees here certain very large nuclei, constricting at various points as if in an act of giving rise to nuclei by gemmation. Mitotic figures are also seen in the endoderm. A part of the endoderm of the embryo soon becomes much enlarged and vacuolated, and is evidently the seat of active secretory processes connected with the digestion of the yolk. The amitosis can thus be considered as coming in line with Ziegler's view that it is an accompaniment of secretory activity in the cells, but it is not in accord with that part of his theory which attaches amitosis to cell senescence. The embryo possesses peculiar external organs, the larval kidneys, which gradually assume a large size, though purely provisional structures. They lie directly under the velum and are made up of ectodermal cells swollen to huge dimensions by the accumulation within them of a homogeneous, faintly-staining material. It is generally supposed that these are excretory organs. In the outer ends of the cells one finds strong indications of amitosis. Here, of course, amitosis is occurring in cells which, though an important part of the body of the larva for the time being, are in reality secretory cells and not destined subsequently to give rise to new cells. Nuclear divisions are found in the food-ova, which are plainly degenerative, and the ova soon after break up and lose their identity altogether. These nuclear divisions appear to be amitotic. They are clearly connected with cell senescence.

**On the Morphology of Artificial Parthenogenesis in the Sea-urchin, Arbacia:* S. J. HUNTER, University of Kansas.

The unfertilized eggs of *Arbacia* subjected to the influence of sea water concentrated by evaporation to three fourths its normal volume for about two hours may, when transferred to sterilized sea water, develop into free-swimming plutei. The subsequent behavior of the eggs is dependent upon the stage of maturation attained when placed in the concentrated solution. Both cytoplasm and nucleus are concerned in development. Eggs isolated and placed under continuous observation until blastulation at first become amœboid, nuclear division following, sometimes repeated several times before cleavage of cytoplasm occurs. Cleavage is not total nor progressive, partial or complete fusion of blastomeres intervening. Cleavage prior to blastulation is at no time comparable with normal processes. Different embryos show wide variations in character of external changes. At blastulation ectoderm cells are formed over large cells, generally three in number. The blastula does not become ciliated and free-swimming before nine hours. Mesenchyma cells are thrown off from the vegetable pole into the blastocœle. The amœboid activity spoken of begins at

about the time of first cleavage in normal fertilization, the rate of development falls gradually behind the normal, being in specific cases as 2:3 at the moment of active swimming, and 1:2 in time of development of pluteus. The artificial gastrulæ are less symmetrical and less active than the normal forms. The pluteus three days old, by measurements, equals in size the normal pluteus a day and half old, differing in lack of symmetry and poorly developed skeletal spicules. Mouth, œsophagus and stomach are present, but no anal opening has been noted. Development in fused fragments is similar to that of the whole egg, except that no fusions are known to have become plutei. No membrane appears, but a perivitelline membrane surrounds eggs placed in a solution composed of 50 cc. of 2½ *n* $MgCl_2$ solution and 50 cc. of sea water for from one to two hours. The same effect, though in not so great a percentage of eggs, is obtained by use of 2½ *n* NaCl solution in same proportions.

The primary nucleus equals in size and eccentric position in egg (as revealed in sections) the nucleus of oötids measured in sections of the ovary. The nucleus advances to the center, enlarges. A small aster with central dark body (parthenocentrosome) appears in contact with exterior of nuclear membrane. This divides to form the amphiaster. The various phases of mitosis ensue. The chromatin nucleolus contributes to formation of chromosomes. These are between twelve and fourteen in number. In a few cultures the nucleus was amœboid in movement and amitotic in division. From such cultures no larval forms developed. Both cleavage asters and cytasters contain central bodies similar to centrosome of fertilization. These bodies appear to be formed *de novo,* and in the case of the cleavage asters there is evidence which suggests that their origin may be in the second polar body. Cytasters appear to divide and are sometimes centers of cleavage. They are more abundant in oötids placed in the concentrated solution. Nuclear division is not necessarily followed by cytoplasmic cleavage. Cleavage of the cytoplasm is preceded by nuclear division.

**Biological Interpretation of Skew Variation:* Frank E. Lutz, University of Chicago. (Read by title.)

A departure from the 'normal' curve of biological measures may be brought about either (1) by removal of a number of individuals from one side of the mean, (2) by increase of individuals or (3) a combination of the two. In skewness caused by removal, we have, in the sign of the skewness, a prophecy of the direction of variation. In skewness caused by the starting of a new race about a mean within the range of the old race, skewness would be prophetic at the beginning of evolution and historic at the end. The distance between the two means is a factor determining the uni- or bi-modality of the combination curve. Skewness as the result of both addition and removal seems too complicated for present analysis. And in no case have we, at the present time, enough data to interpret definitely, in any particular case, the significance of skew variation.

The Correlation of Brain Weight with other Characters: Raymond Pearl, University of Michigan.

**The Relation between the Law of Ancestral Heredity and Mendelianism:* Frank E. Lutz. (Read by title.)

The 'purity of the germ' idea applies quite as well to the law of ancestral heredity as to Mendelianism and is in harmony with it. The confusion seems to have arisen because of the difficulty in distinguishing between the different grades of intensity of the characters used in certain

lines of work. If we suppose four males, having conditions of the character in question, which we may represent as *ab, ef, ij* and *nm*, borne by their germ cells, to mate with four females bearing this character in the conditions *cd, gh, kl* and *op;* and if we mate their successive generations, we shall always get the old Galtonian formula. If, however, we suppose the conditions of the character, which we have represented by various letters as borne by the males, to be indistinguishable *inter se*, so that we may represent them all by x; and, likewise, those of the female by y; and if we then go through the same hypothetical mating as above, we get the Mendelian formula. It would be dangerous to insist upon a strict adherence to 'purity of the germ.' External and internal factors undoubtedly influence it. It is also improbable that a case could be found in which, by careful work, gradations of the character in question could not be found. We would, therefore, conclude that the Mendelian school arose either by an unfortunate selection of data (taking something in which the variations of the character were hard to perceive and measure), or by a careless handling of the data used.

Evolution without Mutation: C. B. DAVENPORT, University of Chicago.

While recognizing that mutation is an important factor in evolution, the author finds, from a statistical study of geographical and paleontological series, that the transitions between species of the scallop (*Pecten*) may be graduated, and of the order of individual variations. Thus the Pectens from Cape Hatteras are intermediate in their qualities between those from Cold Spring Harbor, Long Island, and Tampa, Florida.

Also the fossil *Pecten ebonus* of the Pliocene Nansemond River (Virginia) beds taken from the lowest to the highest beds leads in a uniform series towards the recent *P. irradians* of North Carolina.

**Studies in Compensatory Regulation:* CHARLES ZELENY, University of Chicago.

The ontogenetic development of the opercula in the serpulid *Hydroides* corresponds very closely with the probable phylogenetic development. The regeneration, however, does not agree with the ontogeny. In both ontogeny and regeneration there is a close correlation between the two opercula, and each side has the potentiality of forming a functional operculum. When one side has a lead in development at the start it restricts the other to a rudimentary condition. When both have an equal start two functional opercula develop. A similar close relation between organs is shown in other cases. In the serpulid *Apomatus* after removal of the branchiæ and opercula, the differentiation of the new opercula is much more rapid when the posterior region of the body is also cut off than when this region is uninjured. In the decapod crustaceans *Gelasimus* and *Alpheus*, when both chelæ are thrown off the animals pass through the succeeding molts sooner than when no chelæ, or only one, is removed. Finally, in the ophiurid *Ophioglypha*, the rate of regeneration of the arms is greater the greater the number of removed arms, with the exception of the case where all are removed.

Iridescent Feathers: R. M. STRONG, Chicago, Ill.

**Study of Cross-sectional Courses through the Brain with Cortex Surface Relations by Aid of Fuiler Sections and Models:* CHARLES H. HUGHES, St. Louis. (Read by title.) To be published in *The Alienist and Neurologist.*

The Morphology of the Vertebrate Head from the View-point of the Functional

Divisions of the Nervous System: J. B. Johnston, University of West Virginia. (Read by title.) To be printed in the *Journal of Comparative Neurology and Psychology.*

The Vascular System and Blood Flow in Diplocardia communis Garman: Frank Smith and J. T. Barrett.

Diplocardia communis is a species of large earthworms that are abundant in Illinois and that have a vascular system which may be profitably studied for the light thrown on disputed points concerning the blood flow of other species. Posterior to VI. the dorsal vessel is double in each somite. In IX. to XIV. there is a distinct supra-intestinal vessel which at its extremities joins the vascular plexus of the œsophageal wall and is connected with it by several short branches in each of the somites X., XI. and XII. There is nothing peculiar about the ventral vessel. A subneural and lateral-neurals are absent. A pair of lateral-longitudinal vessels connects anterior capillaries with the œsophageal plexus of somites IX. to XIII. inclusive. From it they extend outward to the body wall and posteriorly along the latter in the clitellar regions (XIII.–XVIII.). Three pairs of dorso-intestinal hearts in X.–XII. force blood from the dorsal and supra-intestinal into the ventral. Paired dorsal hearts in V.–IX. force blood from the dorsal into the ventral. In each somite posterior to XX. one to three intestino-tegumentaries connect the intestinal wall with each dorso-tegumentary at points near the body wall. Observations of pulsations and of the results of clamping and cutting vessels have led to conclusions of which the following is a brief summary: In *D. communis* the blood flows anteriorly in the dorsal; anteriorly in the ventral in front of the hearts and posteriorly back of them; posteriorly in the lateral-longitudinals into the œsophageal plexus of IX.–XIII. and then partly into the supra-intestinal and partly to the clitellar regions. Blood flows outward from the ventral through ventro-tegumentaries to the body wall, nephridia, nerve cord; and through ventro-intestinals to the intestine. Blood flows into the dorsal from the intestine through the dorso-intestinals and from the body wall, nephridia, etc., through the dorso-tegumentaries. Through the intestino-tegumentaries blood flows from the integument to the intestinal wall. These results closely accord with those of Johnston and Johnson on *Lumbricus terrestris* as far as the vessels correspond, and differ materially from those of other observers on that and other species.

**The Diffusion of North American Hawk Moths:* F. M. Webster, Urbana, Illinois.

The paper shows the probable northern trend of diffusion from the tropics through the Antilles into Florida, and through Central America and Mexico into the southwestern and Pacific Coast states, or from Honduras into the West Indies and thence to Florida, and their diffusion from these points of entrance into the United States over North America.

**Insect Life above Timber Line in Colorado and Arizona:* Francis H. Snow, Lawrence, Kansas. To be published in the *Kansas University Science Bulletin.*

This paper calls attention to the difference in the character of insect life in the two locations. In Colorado the species above timber are generally peculiar and, for the most part, not found below timber line. In Arizona the species above timber line do not differ from those below timber line. Illustrations are given. The reason suggested is that the glacial ice mass did not extend to the Arizona summits.

**The Salmonidæ and Thymallidæ of Alaska:* Barton Warren Evermann, Washington, D. C. (Read by title.)

The total number of species of Salmonidæ now known from Alaskan waters is 17, distributed among genera as follows: *Coregonus,* 3; *Argyrosomus,* 3; *Stenodus,* 1; *Oncorhynchus,* 5; *Salmo,* 3; *Cristivomer,* 1, and *Salvelinus* 1. Of the closely related family of Thymallidæ there is one species, *Thymallus signifer.* This number is much greater than is known from any other region; and as regards the number of individuals of important species of Salmonidæ, there is no other region that approaches Alaska. The Pacific salmons (of the genus *Oncorhynchus*) are by far the most abundant, one or more of the five species literally swarming in every suitable stream at spawning time. These are all anadromous fishes, spending the greater part of their lives in salt water, entering fresh-water streams only for spawning purposes. Immediately after spawning all the individuals of Pacific salmon, of whatever species, die, none surviving the spawning act and none ever returning to the sea. The eggs do not hatch until several weeks or even months after the fish that produced them have died, and, therefore, no Pacific salmon ever saw either its offspring or its parents; the generations never overlap. While many of the facts in the life histories of these salmon are now well known, there are many others which remain to be worked out. The Bureau of Fisheries is now taking steps looking towards a careful and thorough study of the salmon streams of Alaska and the life histories of the various species of salmon. During the recent investigations of the Alaska Salmon Commission many important facts were determined regarding these fishes. Much new information was secured regarding the habits and distribution of the Dolly Varden trout and the cut-throat trout, and the presence of a species of rainbow trout in southeast Alaska was first made known. A fine series of specimens of the fishes of the upper Yukon, including the Arctic grayling, was also secured.

**Preliminary Description of a New Family of Gymnoblastic Hydroids from the Hawaiian Islands:* C. C. NUTTING, University of Iowa. To be published in connection with a report on the hydroids of the Hawaiian cruise of the *Albatross,* U. S. Bureau of Fisheries.

The Development and Relationships of the Rugosa (Tetracoralla): J. E. DUERDEN, University of Michigan.

The paper gives: (1) A brief historical account of the various theories which have been held with regard to the nature and relationships of the extinct group of corals, the Rugosa or Tetracoralla; (2) the conclusions of the author from the examination of a large number of species in the light of more recent results on living Zoantharia. At different times the Rugosa have been supposed to be related to the Hydrozoa, Ceriantheæ, Alcyonaria, Scyphomedusæ and modern hexameral corals. The last view prevails mostly among English writers, the distinctness of the group being maintained by most German and French authors. The present investigations have been carried on mainly by the method of grinding down of individual coralla, each successive stage in the growth being drawn as it appeared. In this way the complete development and relationships of the septa have been established. In every instance where the perfect tip has been preserved a cycle of six septa is found to occur, thus demonstrating the primary hexameral relationships of the Rugosa as contrasted with the tetrameral usually assumed. The subsequent septa appear in only four of the six primary chambers and in a manner differing altogether from that in modern corals. The conclusions reached are that the Rugosa must remain as a distinct group of the Zoantharia, related in their proto-

septal stage to modern corals and actinians, but later developing in an altogether characteristic manner. Of modern forms they are most closely allied to the zoanthids, which are without any true skeleton; in these the growth of the mesenteries takes place in a manner comparable to that of the septa in the extinct forms, though proceeding in only two of the six primary chambers.

Demonstration of Preparations made during a Study of the Life-history of the Cestode Crossobothrium laciniatum (Linton): W. C. Curtis, University of Missouri.

**The Types of Limb Structure in the Triassic Ichthyosaurs:* John C. Merriam, Berkeley, California. To be printed in *American Journal of Science.*

The limb structure in the Triassic ichthyosaurs shows generally a much stronger resemblance to the type of extremity found in the primitive shore forms of the reptilia than is seen in the Jurassic forms. The limbs of Triassic ichthyosaurs show as great a degree of differentiation as is found in the later types. Two fairly definite lines of evolution are noticeable in the paddle structure of the Ichthyosauria, one leading to the broad-paddled Latipinnati, the other leading to the Californian Triassic genera and to the narrow-paddled Longipinnati.

**A New Group of Marine Reptiles from the Upper Triassic of California:* John C. Merriam, Berkeley, California. To be printed in 'Publications' of the University of California.

Marine saurians with abbreviated limbs and slender, elongated snout. External nares median. Temporal arcades slender. Dentition heterodont, posterior teeth flat, anterior teeth slender, conical. Elongated vomer with two rows of flat teeth. Pterygoid (?) with numerous slender conical teeth. This group stands in somewhat the same relation to the typical Rhynchocephalia as that which the Pythonomorpha bear to the Lacertilia. Evidently derived from primitive land or shore rhynchocephalians, it has taken somewhat the same course in evolution as that followed by the ichthyosaurians and parasuchians. From both of these groups it differs very considerably in the structure of the vertebræ, limbs and skull. It is sharply separated from both by the characters of dentition. The name Thalattosauria has been used to designate this group.

An Anomaly in the Arterial System of the Dog: John C. Brown. (Introduced by H. F. Nachtrieb.)

The right subclavian artery arises from the dorsal aorta beyond the origin of the left subclavian artery and passes dorsad to the œsophagus and trachea before reaching the right fore limb. The right fourth branchial arch is entirely wanting.

The Brain and Nerve Cord of Placobdella pediculata: Illustrated by wax models made after the Born method by E. E. Hemingway. (Presented by Professor Henry F. Nachtrieb.)

Placobdella pediculata Moore is a new species of leech parasitic in the gill chambers of the sheepshead. The description of this leech has not yet been published, but will appear in connection with Mr. Hemingway's account of the anatomy of the animal. In general the results of Mr. Hemingway's work confirm the conclusions reached by Whitman for *Clepsine hollensis* and other species. The models represented the brain, the ganglion of a typical somite and the posterior mass of ganglia.

The Mechanism of Feeding and Breathing in the Lamprey: Jean Dawson, University of Michigan. (Presented by Jacob Reighard.)

It was shown that there is no good evidence that lampreys feed except when attached, and that, according to accepted accounts, they breathe when free as when attached, through the external branchiopores. There is thus apparently no occasion for a backward current of water into the mouth, either for the purposes of respiration or for the purpose of feeding, and the published observations and those of the writer show that such a current is of rare occurrence. It would thus appear that the velar valves, water tube and valves of the external branchiopore must serve chiefly for the purpose of enabling a current of water to be directed forward out of the mouth. It was shown that such a current is directed forward whenever the animal cleanses the pharynx or mouth of irritating foreign bodies and whenever it detaches itself. Synchronously with the forwardly directed current there is a closure of the external branchiopore by means of the ectal and ental valves described by Gage. Hence water tube, velar valves and ectal and ental valves of Gage find their explanation chiefly in this forwardly directed current. There was also described a pair of jaws—the velar jaws, connected with the velar valves. These jaws serve to hinder the entrance of foreign bodies into the water tube, and are so arranged as to close when the water tube closes by the action of the velar valves, and to open when the water tube opens through the relaxation of the velar valves. It was shown further that the attached lamprey feeds not only on the blood of its host (as stated by Gage), but also on its soft tissues.

**Some Reactions of Mnemiopsis leidyi:* GEORGE WILLIAM HUNTER, JR., New York City. (Read by title.)

Geotropism.—The animal becomes positively or negatively geotropic under conditions seemingly intimately associated with the given supply of light and degree of temperature. *Stereotropism.*—*Mnemiopsis* exhibits marked stereotropism, especially in the darkness. Large numbers of animals will frequently be found resting in pockets in the eel-grass. They also exhibit this same phenomenon in dishes in the laboratory. *Reactions to Light (Phototaxis and Photopathy).*—Sudden light causes activity; sudden darkness inhibits activity. (This is partly in harmony with the findings of Yerkes on *Gonionemus.* See *American Journal of Physiology,* IX., No. 5.) Orientation with reference to the directive influence of the light rays (phototaxis) was long sought for, but only obtained in a few instances, with very strong or focused sunlight. A large number of experiments were made in dishes covered with strips of red, blue and green glass. It was found that in a given period of time (one to ten hours, observations made every half hour) the greater number of animals were counted under the green glass. The totals from 5 sets of experiments read as follows: Blue, 90; red, 126; green, 235. These results need much more careful study before an explanation is offered. *Effects of Changes in Temperature.*—*Mnemiopsis* is relatively more resistant to changes in temperature than is *Gonionemus* (see Yerkes, *American Journal of Physiology,* Vol. IX., No. 5). Responses to electrical stimulation under condition of decrease of heat show little change in reaction time to 15° C.; lower than that a gradual increase in reaction time until no reaction is reached. Responses to electrical stimulation under conditions of increase of temperature show a slight quickening in the reaction time up to about 29° C. After that a rapid increase in reaction time. *Electrotaxis.*—A definite orientation of the animal is the immediate effect of stimulation with a current of moderate strength (one half to three volts, voltage taken in

dish of water about one inch from the electrode). The body is turned so that the long axis comes to lie approximately in the direction of the current, the aboral end is directed toward the anode, and the animal moves with more or less rapidity (depending upon the strength of the current) to the cathode. With a very weak current the animal may simply orient itself without movement towards the cathode. Still weaker stimulation may simply cause slight muscular contraction and movement of cilia without orientation. Reversal of current causes reversal in the orientation of the animal and reversal in the direction of its progression. The immediate cause of the change in direction of the animal is a reversal in the direction of the beat of the ciliated paddle-plates. In general, these may be said to beat more strongly in the direction of the anode. But orientation is brought about by more vigorous beating of the plates in certain regions of the body—possibly more strongly in the more direct lines of current. Muscular action also aids in orientation and in locomotion. Observations on the action of cilia and muscles under the induced current were also made, but are too incomplete for present notice.

**Mouth Parts and Oviposition of Gall-producing Insects:* MEL. T. COOK, De Pauw University.

Gall-producing insects have two methods of depositing eggs, *i. e.*, on the surface of the plant and within the tissues. In the case of the hymenopterous insects, the eggs are placed within the tissues of the bud, the incipient shoot or in the undeveloped leaves of the bud. There is no indication of chemical stimulus. The gall forms after the hatching of the larva and is probably due to the stimulus from the mouth parts of the larva. The mouth parts are of two forms, those for sucking and those for biting. The strength of the mandibles varies with the firmness of the gall. The stimulus is due to mechanical irritation.

**The Bermuda Biological Station for Research:* E. L. MARK, Harvard University.

**A Theory of the Histogenesis, Constitution and Physiological State of Peripheral Nerve:* PORTER E. SARGENT, Cambridge, Massachusetts. (Read by title.) To be published in the *Journal of Comparative Neurology and Psychology.*

**The Two Chief Faunæ of the Earth:* ALPHEUS S. PACKARD, Brown University. (Read by title.)

From the recent studies on the distribution of several groups of moths, I have been led to review the recent work and views of those who advocate the former connection between South America and Africa, and the possible connection of the southern land-masses with Antarctic land. There seem to be two main centers of origin, *i. e.*, two chief zoological areas—that of the northern and that of the southern continents. To the former Huxley's name, Arctogæa, is by general consent applied. For the southern area Sclater's name, Antarctogæa, may be employed. Indeed, we had thought of this term before learning that the name had already been suggested. Although Gadow extends the term Notogæa so as to embrace the three southern continents, yet it seems preferable to confine it to its former limits. The Antarctogæan area thus includes what are regarded by Blandford, Lydekker and others as two separate realms, *i. e.*, Neogæa (South and Central America) and Notogæa (Australasia, Polynesia and Austro-Malaysia), while Africa south of the Sahara was regarded as a region or dependence of Arctogæa. The opinion, however, that the form and distribution of the continents were very different in past ages from what they are now is gaining ground. Thus northeastern America and western

and central Europe seem to have been more or less connected during and since the Cambrian period, with intermigrations of life-forms. This connection, with probable interruptions, appears to have continued down to the early centuries of the Quarternary. Also, from what little we know of the extinct animals and of the present relations of the plants and animals of the continents south of latitude 20° north, several observers have been led to suppose that these continents were more or less intimately united, and that possibly there were land connections with a former Antarctic continent. From maps, though naturally very hypothetical, published by de Lapparent and Koken, showing the probable distribution of land during the Middle Devonian, South America, Africa, southern Asia and Australia were possibly connected. Towards the end of the Carboniferous period there was probably a more or less continuous extent of land over what is now South America, Africa and Australia. This land connection between what are now separate continents appears to have persisted through the early Mesozoic age (Trias and Jura), though towards the end of the Jurassic Australia became widely separated by the Indian Ocean from Africa, while South America and Africa remained united. Our studies on the distribution of Neogæic and African (Ethiopian) Ceratocampidæ and two related families point to a connection in Cretaceous or early Tertiary times between Brazil and western Africa, thus bearing out the views of Ihering, Gill, Ortmann and others. The former connection of these Antarctogæic continents (whatever may be said of their possible connection with Antarctica) is borne out by the well-known facts in the distribution of certain terrestrial worms, land and fresh-water mollusks, insects, fresh-water fish, Dipnoi, *Peripatus*, amphibians, reptiles, birds and mammals. Our results also suggest that Africa south of the Sahara should properly be regarded as a zoological realm (for which the word Afrogæa is proposed), and not a dependence or region of Arctogæa.

C. JUDSON HERRICK,
Secretary.

AMERICAN SOCIETY OF ZOOLOGISTS, CENTRAL BRANCH.

THE first annual meeting under the present organization was held at St. Louis, December 29 and 30. The following officers were elected for the ensuing year:

President—Professor C. H. Eigenmann.
Vice-President—Dr. S. J. Holmes.
Secretary and Treasurer—Professor F. R. Lillie.
Additional Members of the Executive Committee—One year, Professor G. A. Lefevre; two years, Professor T. G. Lee; three years, Professor Herbert Osborn.

The titles and abstracts of the papers presented appear together with those presented by Section F of the American Association for the Advancement of Science, in Professor Herrick's report printed above.

FRANK SMITH,
Secretary.

SCIENTIFIC BOOKS.

Evolution and Adaptation. By THOMAS HUNT MORGAN. The Macmillan Company. 1903. Pp. 470.

The modern evolutionist is obliged to confess, and somewhat painfully, that the processes connected with 'Darwinism' continue to receive different and conflicting explanations—this, too, in the face of a mass of documents which an ever-increasing number of investigators have been bringing together during the past decades. In token of this lack of concord in interpretation witness two volumes, not mere tracts, which have lately appeared. In the first of these, Plate,* following Darwinian

* 'Ueber die Bedeutung des Darwin'schen Selectionsprincips und Probleme der Artbildung,' Zweite, vermehrte Auflage, 1903, Engelmann, pp. 247.

lines, does not hesitate to declare that 'for the harmony which exists between the living conditions of organisms and their morphological and physiological characters there is at the present time no other scientific explanation than natural selection.' In the second book, on the other hand, Morgan is firmly convinced that as a means of accounting for adaptations the doctrine of selection is largely to be discarded. Morgan represents the newer school of evolutionists, and from this standpoint his book has a timely value, for it is the first non-technical work of its kind. Whether he proves his case satisfactorily—for the work is *parti pris* throughout—is a question which each critic must answer. But all will agree that his work will find its place on the general bookshelves side by side with the volumes of Romanes, Lloyd Morgan, Spencer and Wallace.

Morgan, as he states in his preface, was early led to a belief in the inadequacy of natural selection from his studies upon regeneration, for this process often concerns itself with structures which play no part in strict Darwinism. The author now aims to explain some of these difficulties by mutations.* Thus, keeping in mind especially the results of De Vries, Morgan emphasizes the probability of mutations having occurred broadcast under infinite conditions of manner, degree, place and time. Such mutations produced series of creatures which were suited or unsuited to their particular locality, or were perhaps indifferent. Some, like *Kallima*, were even better adapted to their neighborhood than necessity for survival demanded; others were imperfectly adapted, but surviving in spite, *e. g.*, of bright colors, asymmetry or complicated reproductive processes. According to such a doctrine of mutations organic forms succeed one another kaleidoscopically, their variability becoming largely arrested between the definitely marked periods of change. Thus, if a species be compared to a facet upon which a polyhedron is balancing, the species, like the facet, may oscillate within definite limits. But if the limits of variation are transcended, the entire polyhedron changes its position and comes to equilibrium on a new facet. This plan of variation forms the undercurrent of Morgan's philosophy; through it he sees appearing structures, forms and habits, which have no 'selective value,' their purpose or utility may be partly or wholly *nil*, 'for we can not measure the organic world by measure of utility alone,' yet they appear as perfectly and as plentifully as the crystal-forms of snow. Granted then a galaxy of mutations some of them will fit their surroundings with marvelous accuracy. And with this in mind Morgan develops what he believes is a probable answer to many of the puzzles of shape and symmetry, the mutual adaptation of colonial forms, degeneration (those mutations only surviving which 'we may almost say, have been forced' into a parasitic environment, 'for these degenerate forms can only exist under such conditions'), coloration, life-length, regeneration, individual adjustments, secondary sexual characters and even of sex itself.

It is obviously impracticable for a reviewer to consider more than the barest outlines of a work which touches many fundamental viewpoints. Each of the dozen chapters of the present book contains enough to warrant separate reviews and reviewers. And each critic will find little trouble in pointing out some of the many 'pitfalls' referred to in Morgan's preface. For discussions in evolution have long since shown that facts may be read in different ways.

There are general features in which the present volume deserves warm praise, as in providing a mass of helpful examples, and in urging attractive arguments against many 'purposeful' or 'useful' variations, and above all things in considering critically the doctrine of sexual selection, furnishing against the latter—in spite of lack of reference to Cunningham's work—the most serious objections hitherto given. There are other features, however, in which improvement might well have been made. Regrettable is a general dearth of exact references—there are, in fact, not a dozen citations in all. And especially regrettable, in view of the scope of the

* The Lamarckian hypothesis is given little importance: 'I am not sure that we should not be justified at present in claiming that the theory is unnecessary and even improbable.'

book, is the total absence of treatment of vitalism, which, as all admit, has become too troublesome a specter to be ignored in problems of adaptation. Regrettable is this omission, none the less, since there are few authors in a better position than Morgan to summarize the strongest arguments of the neovitalists. Altogether the book would have been more valuable, it seems to me, if the author had readjusted somewhat his themes; he might thus have included a discussion of vitalism, amplified his section on Naegeli's 'perfecting principle,' and given a more adequate account of orthogenesis, respects in which the work is not to be mentioned in terms of Plate's, and by the same token abridged his discussion of natural and artificial selection. As it stands, the work gives page after page quoted from Darwin—indeed, throughout the entire book there are over a hundred pages in quotation marks. This extended treatment of the classic aspects of selection, we freely admit, led us to the false hope that the newer theme of organic selection, as set forth by Osborn, Lloyd Morgan and Baldwin, would at least be given definite reference.

As already remarked, each reviewer of a work of the present broad scope will find abundant ground for criticism. The most formidable and most pertinent discussion might easily arise over mutations themselves. Morgan, like Korschinsky and De Vries, holds that mutations are saltations by which new 'modes' are established in organisms, while variations, in the sense of the usual selectionist, are changes occurring about the same 'mode.' But we find that Morgan is willing to go further, and embrace under the term mutation all discontinuous variations. And if this point is granted, I confess that I can not see that his standpoint is widely different *in esse* from that of the rank and file of latter-day selectionists. For after all discontinuity in variations is a question of degree, and it would not be a serious matter to show that transitions occurred between discontinuous to continuous variations. A case, one which I happen at the present moment to be interested in, occurs in the development of *Chimæra*. In the fertilization of this form supplemented spermheads, as they pass into the egg, divide at once amitotically. And we have thus what appears at first sight a distinct saltation from the usual conditions in polyspermy. Comparing, however, *Chimæra* with the conditions in the allied sharks, we find that this peculiar behavior of the sperm nuclei is not a feature which has arisen as a discontinuous variation; it represents nothing more nor less than an abbreviated process of what occurs in the more primitive sharks; in these forms amitosis in sperm nuclei appears at the end of a graded series of nuclear divisions, a series at one end of which mitosis occurs, and at the other amitosis. In the development of *Chimæra* the earliest stage of the sperm nucleus thus corresponds to a late stage in the sperm nucleus of sharks, and thus we conclude that the discontinuous character in *Chimæra* is not a new 'mode,' but a modified phase of a simple continuous process. This example, be it understood, occurs not immediately between offspring and parent, but, like 'mutations' in paleontology, between offspring and early ancestor, but it seems to me that a typical mutation differs from it in degree rather than in substance, and that similar processes may combine to form the complex of wonderfully adjusted discontinuous variations which we call a typical mutation. I incline to the belief that, in the elaboration of the doctrine of mutations, Morgan, like some other transmutationists,* keeps too prominently in the foreground not the strands which make up the complicated web of adaptation, but the mutant as a whole, picturing not the few details of structure which our present knowledge enables us to grasp, but a progression of brilliant, perfectly formed organisms, delicate in internal adjustments and *new*, different from their parents, indeed, even from their earliest stages, a picture which, as Morgan says of Naegeli's progression 'has a grandeur that appeals directly to the imagination.' On the other hand, admitting that discontinuous vari-

* Morgan substitutes 'transmutation' for 'evolution,' adjusting the term more closely, therefore, to his interpretation of the process. If terms are to be shifted, why should not the Lamarckian 'transformism' be revived?

ations ('mutations') are in themselves but adaptations of continuous variations, and bearing always in mind that extreme mutations are numerically rare, and, in our present knowledge, obscure as to fate, I take it that we are hardly in a position to give them supreme importance in the economy of species-building. Of extreme interest they are, none the less, and from theoretical standpoints, they are worthy of the most painstaking research, and are not to be discredited as mere 'freaks' or 'sports' important only in the praxis of gardening, as Plate concludes. There is, furthermore, a feature of mutations which has, it seems to me, never been adequately considered, *i. e.*, the definiteness of their characters, a feature which tells rather in favor of orthogenesis than the less definite interpretation which Morgan supports. For in all mutations—we refer to typical cases—the creature which appears is constant to a remarkable degree; the peacock mutant is the black-japanned, never the yellow- nor the red-, and even when many mutants appear 'simultaneously' they are surprisingly constant in characters. The word orthogenesis, by the way, does not occur in the index, and in similar instances we find that the index is troublesomely brief.

It is, I conclude, as a postulate of his doctrine of mutations that Morgan attacks our venerable recapitulation (or, as he prefers to call it, *repetition*) theory. For when a mutation does occur it appears literally *ab ovo*, although the author does not commit himself as to the exact point at which the *'presto change'* occurred, whether in fertilization or segmentation, but, if I understand him aright, it occurred during earliest development; nor does he say concretely whether all mutants date from an identical stage. But the drift of his remarks on recapitulation leads us to infer that they do, for otherwise this chapter seems to lose its point. For, outgrowing the days of Oken, no author of good repute has maintained that the *adult* structures of ancestors are still present in embryos, nor that the embryo chick resembles an *adult* reptile, nor even that the embryo of one species is ever exactly identical with the embryo of the corresponding stage of the nearest species. We might even go further and assert that no modern zoologist has maintained that even within the same species any individual is absolutely identical with any other individual at any corresponding stage, early or late, in growth. Even the enthusiast who substituted a cut of an embryonic dog for one of man, and cheerfully admitted the imposture on the ground that the figures were equivalent, has never been charged with believing that the stages *were* equivalent, but only with crudely illustrating an elementary text-book, and with unscientific levity. Morgan's therefore must imply something more than the doctrine of von Baer—which was to the effect that chick embryos resemble (he does not say are absolutely identical with) embryos of lizards, and that the stages of chick and lizard correspond during a longer period of development than do embryos of chick and fish. And I have gathered what I believe is his meaning only piecemeal, through his references to larval forms, his assertion that 'jumps, or short cuts, of the developmental process are unknown in the physiological process of development,' and his quotations regarding the early appearance of mutational characters in the development of birds and dogs. He entirely fails to appreciate, it seems to me, the part played by adaptation at all stages of growth.

A final word regarding useful variations. Morgan maintains (and we believe that the majority of zoologists are in sympathy with such a view as opposed to Wallace's) that many 'useful' characters in organisms are useless and accidental, even although, *a priori*, the case appears adapted to purpose in marvelous detail. We smile at the silhouetted skull on the back of a moth, or the head of the drowned Taira warrior on the carapace of a Japanese crab, or the profile of a Scandinavian face on the 'earbone' of a Norwegian whale, but are these complicated coincidences more accidental than some of the 'purposeful' variations which we accept rather on the faith of coincidence than upon actual proof of utility? Facts are clearly what we need before we can assert that definite characters or variations are useful—but it is equally true

that facts must be cited before many of the stock examples of 'useful adaptations' can be cast out. And from this standpoint a number of Morgan's examples of non-useful adaptation fail to convince. Thus, why may not the different colors in the mouths of the male and female hornbills be useful in sexual selection? Morgan assures us that these differences in the colors are useless since they can not be seen, but on the other hand, from what we know of the habits of huge-billed birds, it is quite possible that during nuptial antics the bills are widely open. Again, Morgan admits that the green color of a frog is probably useful, but believes useless the black pigment lining the body cavity. He does not show that it *is* useless, in spite of our lingering suspicion that a black screen behind a thin body wall might well be useful in collecting warmth, or even in protecting from light delicate viscera. So, also, we are not convinced that gray hair and retreating chin are altogether useless organs, for it is quite possible that there is some foundation for the popular belief that they are adverse to sexual sentiment, and may thus, after all, play a useful part in selection.

BASHFORD DEAN.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Physical Chemistry, November. 'History of the Water Problem' (Mrs. Fulhame's theory of catalysis), by J. W. Mellor. A sketch of Mrs. Fulhame's 'Essay on Combustion,' published in 1794, in which appears the first clear statement of the influence of water on chemical transformations. 'An Apparatus for the Electrolytic Determination of Metals, Using a Rotating Cathode,' by E. S. Shepherd. By this means the copper in chalcopyrite was determined electrolytically in from twenty-five to forty minutes. 'Solubility of Calcium Sulfate in Aqueous Solutions of Sulfuric Acid,' by F. K. Cameron and J. F. Breazeale; 'The Solubility of Magnesium Carbonate in Aqueous Solutions of Certain Electrolytes,' by F. K. Cameron and A. Seidell. *December.* 'Action of Sodium and Potassium Amalgams on Various Aqueous Solutions,' by Gustave Fernekes; 'The Rate of Formation of Iodates in Alkaline Solutions of Iodin,' by E. L. C. Forster; 'Iron Salts in Voltameter Solutions,' by J. M. Bell.

SOCIETIES AND ACADEMIES.

THE WASHINGTON ACADEMY OF SCIENCES.

THE annual meeting of the Washington Academy of Sciences was held on Wednesday evening at the Cosmos Club and the following officers were elected for the ensuing year:

President—Charles D. Walcott.

Vice-Presidents—From the Anthropological Society, D. S. Lamb; Archeological Society, J. W. Foster; Biological Society, B. W. Evermann; Botanical Society, F. V. Coville; Chemical Society, F. W. Clarke; Entomological Society, W. H. Ashmead; Geographic Society, A. Graham Bell; Geological Society, G. K. Gilbert; Historical Society, W J McGee; Medical Society, C. W. Richardson; Philosophical Society, C. F. Marvin.

Secretary—Frank Baker.

Treasurer—Bernard R. Green.

Managers: 1905—L. O. Howard, O. H. Tittmann, Carroll D. Wright; 1906—C. W. Hayes, G. W. Littlehales, C. Hart Merriam; 1907—Geo. M. Kober, Gifford Pinchot, F. A. Lucas.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 33d annual meeting, December 19, 1903, Professor C. F. Marvin, of the Weather Bureau, was elected president; Messrs. Abbe, Hagen, Littlehales and Day, vice-presidents; Mr. B. R. Green, treasurer; Messrs. Hayford and Wead, secretaries, and Messrs. De Caindry, Paul, Winston, Bauer, Briggs, Fischer, Harris, Rosa and Abbot as members of the general committee; on this committee are also *ex officio* Past Presidents Dall, Walcott, Rathbun and Gore.

The secretaries' and treasurer's reports showed the society to be in a prosperous condition.

THE 577th regular meeting was held January 2, 1904, President Marvin in the chair.

Mr. F. G. Nutting presented by invitation a paper on 'The Electron Theory of the Radiation of Gases,' pointing out how this theory explains various peculiarities in the spectra of gases.

Mr. C. G. Abbot then described work of the past two years at the Smithsonian Astrophys-

ical Observatory, consisting in measures of the transparency of the air, the rate of receipt of solar energy at the earth's surface, and computations therefrom of the 'solar constant' of radiation and of the probable temperature of the sun.

The transparency of the air, measured at many different wave-lengths by the aid of the spectro-bolometer, had appeared to vary greatly, so that the means for the first eight months of 1903 fell below the means for 1901–2 by amounts ranging from five per cent. in the infra-red, to twenty per cent. in the blue. During the latter four months of 1903 the transparency had again risen, and approached within two or three per cent. of its values for the year before.

Results were given of some twenty separate determinations of the solar constant, but these depended directly on the constants and theory of the mercury pyrheliometer, so that they may later be subject to amendment. In response to questions Mr. Abbot described a new form of pyrheliometer capable of exact checks on its results, and now being tried with most promising results at the Astrophysical Observatory.

A curve was shown giving the mean of five days' determinations of the distribution of solar radiation outside the atmosphere. From this the position of maximum radiation appeared at a wave-length of 0.49μ, corresponding, according to Wien's law, to a solar temperature of from 5800° to 5900°.

Dr. Day remarked that the mean value of the solar constant, as given by Mr. Abbot—2.167 calories per cm.^{2} per minute—would yield by Stefan's law a solar temperature of 5700° to 5800°.

Charles K. Wead,
Secretary.

NEW YORK ACADEMY OF SCIENCES.
SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

The regular meeting of the section was held on January 4 at the American Museum of Natural History. The officers of the section for the year 1904, who were elected at the last regular meeting of the section, are:

Chairman—Professor Charles Lane Poor.
Secretary—Mr. Charles C. Trowbridge.

The first paper of the evening was read by Professor Herschel C. Parker and was entitled 'Altitude Observations with the Hypsometer in the Canadian Rockies.'

A brief outline of the various methods used in altitude determinations was first presented, showing that all are based on two general methods, triangulation or measurement of atmospheric pressure. In the latter method the determinations are made either by means of the several forms of barometer or by the hypsometer. The difficulties attending the use of all of the different forms of barometer were pointed out and the advantages of portability and accuracy of the hypsometer shown. Examples were then given illustrating the extremely satisfactory results obtained with the hypsometer during mountaineering expeditions in the Canadian Rockies last summer.

Professor Parker has had many years' experience in mountain work, making numerous 'first ascents' in British Columbia and Alberta, and he gave as his conclusion that the hypsometer is by far the most convenient and accurate instrument for the determination of altitudes under ordinary mountaineering conditions.

The second paper was read by Dr. George F. Kunz and Professor Charles Baskerville on 'Phosphorescence in Diamonds Produced by Pitchblende.' They stated that a naturally fractured piece of pitchblende (uraninite), weighing 800 grams, from Pribram, Bohemia, caused the 14$\frac{1}{32}$ carat diamond (tiffanyite) * to phosphoresce when laid upon it, or even when a piece of window glass or a board three fourths of an inch thick was interposed. The diamond glowed, although more than one inch of space intervened between it and the pitchblende. We have in this instance a substance with a radio-activity of only 2 or 2$\frac{1}{2}$ affecting a radio-actively responsive substance, proving that there exists a body of the latter character in this case that responds almost to the unit one of radio-activity. The same specimen of pitchblende did not affect a platinum-barium cyanide screen. Another specimen of pitchblende from Pribram, and others from

* Science, December 18, 1903.

Johanngeorgenstadt, Saxony, and Central City, Colorado, caused the diamond to phosphoresce. It was further shown that if either kunzite (a variety of spodumene), pectolite or wollastonite, pulverized, were mixed with radium-barium carbonate, of 240 activity, the mixed powder became permanently luminous. When these mixtures were put in a Bologna flask and held on a metal plate, hot but not showing any color, they immediately became very luminous and remained so for a long time. Kunzite, pectolite and wollastonite became phosphorescent by heating alone, the kunzite showing an orange glow. When a kunzite crystal 5 cm. square and 5 cm. thick was exposed to the passage of an oscillating current, the entire crystal glowed an orange pink, losing its lilac color, a well-defined line through the center in the path of the current being much more brilliant; this phosphorescence lasted for quite a time after exposure. Further experiments were made with the same sensitive diamond mentioned above as to its tribo-luminescence. Prints were obtained from negatives made by laying the diamond face downward directly upon the photographic plate, and rubbing the back of the diamond with a stick coated with wool, in one instance for a quarter of a minute, in another for one half minute, the tribo-luminescence induced causing the printing. The same type of diamond from British Guiana, when heated on a metal plate below redness, phosphoresced distinctly, as also did pectolite and wollastonite. We have here, therefore, luminescence of the tiffanyite body in diamond, produced by radio-active pitchblende, by friction and by heat.

The next paper on the program was the first of a series of papers on 'Recent Progress in Physical Science,' and was delivered by Dr. Bergen Davis, who spoke on 'The Latest Theories Relating to the Discharge of Electricity in High Vacua, and Ionization of Gases.' Account was given of Dr. H. A. Wilson's investigation of the distribution of electrical intensity along the striated positive column, and his theory for the electrical intensity in a uniform positive column. An outline was also given of Professor J. J. Thompson's theory of the discharge through Geissler tubes. Dr. Davis also reviewed Professor J. S. Townsend's theory of the sparking potential, Professor Townsend having showed that the ionization is due to impact of both positive and negative ions with the neutral molecule. The theoretical sparking potential thus deduced agrees very closely with the experimental value.

CHARLES C. TROWBRIDGE,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.
NEW YORK SECTION.

AT the meeting held on January 8 at the Chemists' Club, 108 West 55th Street, the program was as follows:

The Dietetic Value of Patent Foods: W. D. HALLIBURTON.

Professor Halliburton, who was present as the guest of the section, spoke especially of the conditions influencing the digestibility of various foods and dietetic preparations, the relative importance of nitrogenous and non-nitrogenous nutrients, the disadvantages of separating a single nutrient from the other constituents of the food in which it occurs, and the question of the nutritive values of meat extracts and proteolytic products. It was pointed out that while the meat extracts are practically devoid of food value, the preparations which consist of proteolytic products, such as proteoses and peptones, have practically the same nutritive effect, 'nitrogen for nitrogen,' as the original proteids, being synthesized to proteids in the body, probably in the epithelial cells. In conclusion Professor Halliburton urged the cooperation of chemists with physiologists and physicians in the education of the public, and the prevention of fraud in the matter of artificially prepared and 'patent' foods.

Notes on the Preparation of Standard Alkalimetric Solutions: F. D. DODGE.

Dr. Dodge reviewed the principal methods employed and discussed especially the merits of various acid and alkaline substances which have been suggested as standards for use in the direct methods of standardizing. For this purpose he proposes the use of salicylic acid

for titration in alcoholic solutions, and of the acid phthalates where aqueous solutions are to be used. In the discussion following the reading of this paper, Professor Coblentz spoke highly of tartaric acid and acid potassium tartrate as standards for titration in aqueous solutions.

On the Structure of Metals and Alloys; Aluminium Alloys: William Campbell.

Dr. Campbell, after describing the microstructure of the whole series of alloys of copper and aluminium, and the change in structure due to casting, dwelt at some length on the change which takes place in the solid state in alloys containing over 84 per cent. copper. It appears that the alloys solidify as solid solutions, and at a lower temperature rearrange themselves in a manner similar to that of the alloys of copper and tin between 68 and 75 per cent. copper, or of the carbon-iron alloys containing up to 1.8 per cent. carbon. Photographs of the alloys which had cooled slowly were contrasted with those of alloys which had been quenched from above the critical temperatures. On annealing the quenched specimens, the original structure was restored. The paper was illustrated by lantern slides.

The Determination of Molybdenum in Steel: F. V. D. Cruser.

Mr. Cruser described the analytical separation of molybdenum from iron and the rarer metals now added in making steel, such as chromium, tungsten, uranium and vanadium, and the various methods used for the determination of molybdenum. In the course of the work it was found that the separation of iron from molybdenum by caustic alkali was inaccurate, due to the formation of small but variable quantities of ferric molybdate which was soluble in alkali. A method was worked out which is believed to be entirely accurate; it is in brief as follows: Dissolve the steel in nitrosulphuric acid; separate the molybdenum as MoS_3 by hydrogen sulphide under pressure; dissolve the sulphide and convert to sulphate; reduce the molybdenum by zinc and reoxidize by a standard solution of permanganate. If tungsten is present the addition of three to four grams of tartaric acid prevents its contaminating the molybdenum sulphide. This method was tested on a number of steels and molybdenum alloys, and none of the metals present was found to interfere, while by the methods recently published the results were unreliable in many cases, especially when tungsten or vanadium was present.

On the Determination of Nitrogen in Food Materials and Physiological Products: H. C. Sherman. Read by title.

H. C. Sherman,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONVOCATION WEEK.

The multiplication of scientific and learned societies is the normal outcome of the enormous expansion in the fields of learning during the past few decades. The farther one pursues a single branch, say of science, the more he becomes separated from those following other branches of science. The scientific society represents, like all other societies, the grouping of those of similar tastes for mutual profit and entertainment. As soon as a society covers a field so large that many of the matters brought before it are uninteresting or unprofitable to any considerable number, the society breaks up, either into new societies or into sections, each with its own gatherings. This fact was recognized early in the history of the American Association.

But specialization can be carried too far. I do not mean merely that the man, mining so industriously at the bottom of his own shaft, is of little account to the rest of the world, indeed, often forgets that there is any world outside of his own hole. He himself may recognize that this is true and not care a whit, so that he discovers the truth for which he is searching. What is of far more importance is that in losing his sense of perspective he greatly hampers his own work. He needs to know what others are doing that he may gain a better conception of what he himself is doing.

We need the meetings of the special societies, and we need also the meetings of a general society, where men come in contact with

the workers in other fields than their own. The value of such gatherings is not so much in listening to papers or addresses, though these are often profitable, but in social intercourse, coming into contact with minds not cast in our own mold. It is particularly stimulating to younger men thus to meet with those who have already won their spurs, and is it not the duty as well as privilege of the latter to give this inspiration to their younger colleagues? The discovery of a man may be as important as the discovery of a theory.

How then shall such an ideal be brought to pass? We have such a society, covering the general field of science, the American Association; what should be its function and what the character of its meetings?

1. In its journal, for such we may call SCIENCE, it is actually accomplishing much to prevent narrowness in specialization. In an hour each week I get a glimpse of what is going on in the world of science. It seems to me that no specialist can afford not to at least glance through the carefully prepared papers on special branches, yet of general interest, the discussions and correspondence, the reviews of literature, the current notes on special sciences (would there were more of them!) and the general notes and news.

2. As regards meetings. Each society should have its regular annual meeting in the summer, for the presentation of papers, for excursions, for study or for whatever is of most value to the members as specialists. For many of the societies summer is the most favorable time for such purposes. These meetings should be held by each society without regard to the meetings of any other society, as to either date or place. In winter there should be a convocation week meeting of all the scientific societies, together with the American Association. At this meeting it seems to me that no papers of restricted interest should be read, but rather presidential addresses and lectures should be given, and sectional discussions (carefully prepared by a limited number of leaders) on topics of general sectional interest. No inconsiderable attention should be devoted to the social side of these annual meetings, but the time should be so apportioned daily that there should be no conflict; that is, a certain portion of each day should be set apart for each general purpose.

All this would necessitate points of adjustment between the sections of the American Association and the various societies. The functions of the sections and the societies are in many respects similar, and the question may well be asked, as it has been many times in the past, as to whether there is a place for both. Would it not be better for the association to become merely a federation of the scientific societies of the country? As it is at present, many members of the different societies attend the meetings and enjoy all the privileges of the association, except holding office and receiving the *Proceedings* of the association and SCIENCE, and contribute nothing to the treasury. Then there is always more or less friction in arranging the sectional programs where there is this dual control. In case of federation, with the council made up, perhaps exclusively, of representatives chosen by the societies, all this would be obviated. The chief difficulty would probably be arranging for the financial support of the federated association. Yet this would be by no means insuperable. It could be provided that each member of the societies should be charged the present dues of three dollars for the support of the federation, receiving therefor SCIENCE as now. Since the addresses would be printed in SCIENCE, the *Proceedings* could be discontinued, and a collective list of members printed in addition to the lists of members of each society now published. The reduced expense would in the end probably amount to as much as the income received from initiation fees, a source of income dependent upon growth in the association. Of course, such a plan would necessitate a certain amount of altruism on the part of the federated societies, but I can well believe a majority of the members of every society would be willing to sacrifice something for the general good of science, even outside of their own specialties.

Such a winter gathering should be held in a large and easily accessible center, in order to insure the largest possible attendance. Here

we meet the difficulty of the great distances separating workers in the various sections of this country. A satisfactory way of obviating this would be to hold a general meeting of the association only biennially, dividing the association geographically in the alternate years, with meetings simultaneously in perhaps half a dozen sections of the country.

Such changes as these suggested are radical, but changes have been going on in the administration of the association for the past decade, and it is evident other changes must come. Would not these meet the requirements?

Jas. Lewis Howe.
Washington and Lee University.

To the Editor of Science: The relation which the various scientific societies of the country bear to the American Association is one which demands careful consideration. First of all I think it may be assumed that the organization of all scientific societies should be of such a nature as to promote the welfare of the American Association. The latter body is the one organization of the United States in which all scientific men are brought together on a common level.

The necessity for special societies is, of course, recognized, but the greater necessity for a single society is equally as evident.

I should like to discuss, for a moment, some of the problems suggested in an article in Science, January 8, on convocation week, and especially with reference to the position occupied by the American Chemical Society. This society now has a membership of nearly twenty-five hundred and is rapidly growing. I have consulted the records of the attendance at the meetings of the American Association for the past few years and find that the members of the American Chemical Society represent about 30 per cent. of the whole attendance. During the whole of this period the American Chemical Society has held its meetings in conjunction with Section C of the association and the utmost harmony and good-will have prevailed. It appears to me, therefore, that the American Chemical Society has a more intimate union with the American Association for the Advancement of Science than any of the other affiliated societies. My idea is that each section of the association would be benefited by the adoption of this system of cooperation. It might even be made more intimate with great advantage. For instance, in the case of Section C the officers of the American Chemical Society might well be accepted as the officers of Section C, thus making Section C practically the American Chemical Society. It is evident at once that the aims and intentions of Section C and the American Chemical Society are the same, and by having the same set of officers there would be less trouble in arranging the program and dividing the time than there is at present. This, however, is only a suggestion, as I realize that the present form of collaboration is very satisfactory.

If all the other branches of science could be represented by powerful national societies the same collaboration could be established in almost all the sections. For instance, there is no reason why there should not be an American Botanical Society of approximately the same numerical strength as the American Chemical Society, and this is true of physics, geology, entomology and the other sciences. It might be well, however, to establish a limit of membership, so that before a subsociety should become intimately associated with the parent society it should have a membership entitling it to such a position. I should say that any national society representing a great science which has a thousand members could safely be admitted to the same affiliation as the Chemical Society now enjoys.

Unfortunately, I think, for the advancement of science, there is too great a tendency to organize separate and independent societies in each branch of investigation. This has been done already in regard to chemistry in this country in the establishment of two very powerful societies entirely distinct from and without any affiliation whatever with the American Chemical Society. I refer to the American Electro-chemical Society and the American section of the Society of Chemical Industry. I do not wish to speak in a reproachful way of these two organizations, because I am a member of both and fully appreciate the great work that each is doing, but it

seems to me that this work might be even more effective if conducted in conjunction with the American Chemical Society.

The same tendency to disintegrate seems to pervade the other sciences. For instance, I note that at the St. Louis meeting there were represented in the American Association the American Society of Naturalists and the American Society of Zoologists. Now, of course, I do not know just what kind of a science naturalism is, but I suppose a part of its work is zoology. I also notice that there were represented the Association of Economic Entomologists and the Entomological Club of the Association, the Association of Plant Breeders, the Botanical Club of the Association, the Botanical Society of America, the Central Botanists' Association, the Wild Flower Preservation Society of America and the Fern Chapter. Again I am at a loss to know exactly what a fern chapter is, but I assume that it has something to do with botany. I also note the presence of some societies which can hardly be associated with any one science, for instance, the 'Sigma Xi Honorary Scientific Society,' the Society for Horticultural Science and the Society for the Promotion of Agricultural Science. Would it not be better for all parties concerned if all these botanical clubs and societies were sections of one great national society? It seems to me, therefore, that the sections of the association devoted to physics could thus become affiliated or become really the American Physical Society, the geological bodies become the American Geological Society, zoologists become the American Zoological Society, the entomologists the American Entomological Society, and all the botanical clubs be united in the American Botanical Society. The presidents of these societies, respectively, would become the presidents of the sections of the association. This would in no way interfere with the autonomy of the national scientific societies, but would unite them all under a common head, namely, the American Association for the Advancement of Science. It would also permit the great national societies to divide up into sections to study special subjects. Separate sections of the American Association could be formed for scientific discussion of general subjects such as economics, medicine, etc. It would, indeed, be excellent if the American Medical Society would become affiliated in a similar way with the association. If all this could be accomplished, instead of having four thousand members of the American Association, we would have four times that number. The moral effect of such a union would be great and its economical effect still greater.

There may be many objections to such a form of affiliation, but judging from experience in connection with the American Chemical Society and its relation to the American Association, I should say that these objections are not fatal. H. W. WILEY.

TO THE EDITOR OF SCIENCE: A response to your inquiry, if a faithful reflection of my convictions, may serve only to range me with a conservative minority on this matter of scientific organization and expose me to the raking fire of the progressists.

I confess to a feeling of apprehension at the insistent and impetuous efforts which are making toward the centralization of scientific endeavor in the United States and the creation of a formidable scientific machine in which individuality is to be reduced to a cog. Scientific organization on a grand scale is claimed in your recent vigorous brief on its behalf, to be important, not for the good of the scientific man, but for that of science, in which particular the science union or science syndicate will differ from the actual genius in the combinations of labor or capital. These are organized emphatically for the benefit of the individuals who are in, not for any such vague objective as the good of labor or the idealizing of business. The ideal man of science may be so supramundane that he can afford to give allegiance to such an altruistic purpose as the enthronement of science regardless of his own interests, but the actual scientific investigator, no whit below the ideal in his ardor, wants to do the work, as much of it as his powers and his years permit, to achieve all within the range of his opportunities; and he also has a just pride in and right

to the honors that he earns and the credit that he wins. If he is laureled by some exclusive society of select spirits wherein the seating capacity is small, some ancient, time-honored fraternity whose notice is recognition of his successful achievement, let him wear his honors. They are well won and were well worth striving for, unless the world is to be made over. But laurels on the wheels of a great machine will be very much in the way.

This central agent of science will, you venture to hope, obliterate all individual rivalry for precedence, all controversy directed to enforce or maintain the individual view or interpretation, and differences of opinion are, I infer, to be adjusted by conference and arbitration; but I hold it the very essence of scientific vigor that the investigator maintain his conclusions against all comers. In keen, well-behaved controversy, more than in conference, in determined and relentless adherence to conviction, rather than in meek surrender to 'the good of the party,' the real vitality of scientific labor reveals itself. If any laborer in your own field of research is weak, faulty in his method, careless of fact and indifferent in deduction, it is somebody's duty to tell him so or the truth may remain concealed, and, I take it, it is the truth we are after and not merely the 'advancement of science.' But a science machine that will do away with all this, throws laurels in the waste basket and calls every one mister, stops the mouths of lions, pools all individuality and makes us all sucking doves and a spectacle for angels, may seem a beneficent institution, for now that all American men of science have been reduced to mere algebraic expressions, tagged and filed, there would be nothing for them but to take their numbers, get their union cards and try to live up to the motto, 'Better to be the tail of a mouse than the head of a lion.'

After perusing your article with care I am disposed to apprehend that centralization of science means the creation of a juggernaut which will crush endeavor, stupefy ambition, incinerate stimulus, minify personal achievement and cachinnate at honor—the sweet recompense which comes from a life of earnest labor.

JOHN M. CLARKE.

January 12, 1904.

TO THE EDITOR OF SCIENCE: I thank you for your invitation to join in discussing the question how best to organize into one cooperative fraternity all our national scientific societies.

I would have the members of the council of the American Association feel that the entire burden of this holy mission rests on their shoulders; that as success would be their crown, its failure would be their undoing; if need be the martyr spirit is to be dominant, and whosoever would be chief, let him be the servant of all.

Say to them, always seek to draw and not to drive, to encourage and not to discourage; to suggest cleverly and not seem to direct; to attract and not to coax or bully. The old saying, Where the carcass is there will the eagles be gathered together, will prove true in their case as in every other. Remember what Jean Paul told us long ago, Not all are always reasonable, but all have feeling—never forget that in addressing them.

I would have the council in this matter generous to a fault. A distinguished botanist living 3,000 years ago or such a matter, who knew the plants of his country from the lichens to the conifers, must have been thinking of our association council when he wrote: 'There is that scattereth and yet increaseth and there is that withholdeth more than is meet and it tendeth to poverty.'

Try to improve your volume of *Proceedings*. It is not altogether hopeless, though you shake your heads. Remember Hercules. Moreover, dear friends, the weekly journal chosen to be the Aaron of our scientific Moses ought to be dignified, true to the truth always, but at the same time moderate in utterance. Surely, surely, no council planning to do missionary work can make friends at the outset by denouncing through its official organ three highly honored institutions of science as having completely failed.

'Let dogs delight,' etc.

Take especial pains to have at the annual gatherings and mass meetings men of distinction, of whom all have heard and whom they desire to see. I recall the long-ago delight with which my young eyes first gazed on E. B. Tylor, and when as a student I held in my

grasp the hand of Lewis H. Morgan. If such men only knew how good the sight of them is to young and longing eyes, they would make sacrifices to give so much pleasure.

Encourage specialization. The closest affiliation of specialists and aggregation into a mutually helpful cooperation are necessary to the intension of a science. It can not be too compact or too lively. The moment they organize the institutional mind is born.

But to the special societies let me say that the beau ideal of learning is to know all about some and some about all. In your meetings the infimæ species of details, instruments and processes are scrutinized and discussed; but in your family gatherings all learn the results of the tedious labors of each. You acquire the ability to read or listen intelligently. Let me illustrate great things by small: There is an old man in one of the dependencies of the Smithsonian who was engaged to write up the textile arts of the American aborigines. Through its many agencies he was furnished with overwhelming material from the whole area between Point Barrow and Magellan Strait; between Nova Scotia and Attu Island. If he had possessed seven league boots, a canoe that shot past the wild geese, the hundred eyes of Argus Panoptes, the hands of Briareus and the longevity of Methusaleh it would have surpassed his powers to bring together so much. But no sooner had he sat down among the stuff than he discovered his lack of omniscience, a quality required of him before taking the first step in so comprehensive an industry. He must know chemistry for dyestuffs, geology for horizons, geography and meteorology for environments, botany thoroughly for plants, zoology for staples and implements, ethnology for peoples, philology for names, not to neglect mythology and folklore for the charming symbolism.

I will not worry you with the long list of the Covilles, Merriams, Holmeses, Houghs, Chesnuts, Willoughbys, Boases, Dorseys, Mooneys and more; nor of the many bureaus and branches of the government that gladly put themselves at his disposal; nor of the leading museums, Peabody, American, Field-Columbian, Golden Gate Park, with the rest, whose treasures illustrate his pages. The thing that bothers him now is what name to put on the title page.

The lesson I would learn from this parable is that the highest possible specialization only makes the closest solidarity that much more necessary. The council has my blessing and best wishes and shall have my cooperation in its endeavor.

O. T. MASON.

January 19, 1904.

SOIL WORK IN THE UNITED STATES.

IN the *Beet Sugar Gazette*, published on December 5, 1903, on page 419 is given an account of the trip of the Secretary of Agriculture through the beet sugar region of Michigan. At Rochester the Secretary made an address in which are found the following words:

"When I went to Washington I found that we had no knowledge of the soils and I went to work and organized a bureau of soils and have over two hundred scientists engaged in this work. I shall send a corps of soil physicists next year to every sugar factory in Michigan to examine the soils, and the information which the Department of Agriculture obtains is at your disposal."

In many other public addresses the Secretary of Agriculture has given expression to similar sentiments, and especially has he criticized the colleges and universities of the United States, because, as alleged, they fail to train their students in such a way as to make them valuable to the Department of Agriculture.

We all know that the Secretary of Agriculture means well and does the best he can for the interests over which he presides. Under his energetic administration, the activity of the Department of Agriculture has been materially increased, and its usefulness greatly enhanced. He does not pretend to be a scientific expert, and we must presume that his ideas on scientific work are mainly the result of the environment in which he lives. It, therefore, becomes an interesting question whence has come to him the information that the agricultural colleges fail to train students usefully in agriculture; that the uni-

versities are doing nothing for the promotion of agricultural science; and that at the time he came to Washington, and until the Bureau of Soils was established, nothing was known about soils—meaning, presumably, the soils of the United States.

In the light afforded by Bulletin No. 22 of the Bureau of Soils, which I have recently discussed in the columns of SCIENCE, the source of the Secretary's information is not far to seek. Having departed from all precedent in the matter of soil work, whether in the field or in the laboratory, in the old world or in the new, the Bureau of Soils simply declares all former soil work to be '*nul et non avenu*'—void and of no effect; and so informs the Secretary.

In view of the existing records, this seems an extreme liberty to take with the facts of the case. It is true that in some of the states, the public surveys and even some stations have taken the soil features but very little into account. But in many others, the soil features have been quite elaborately observed, elaborated and discussed. Beginning more than half a century ago, David Dale Owen conducted the work of the geological surveys of Kentucky and Arkansas; and we find in the reports of these surveys not only the chemical analyses of several hundred soils from these two states, but, accompanying them, descriptions of their physical and agricultural characters, as well as of their native vegetation. Following the lead of Owen, the present writer undertook similar work in connection with the geological and agricultural survey of Mississippi, and from 1857 to 1873 continued these studies from the physical, chemical and botanical standpoint. In 1880, being in charge of the report on cotton production of the Tenth Census of the United States, he undertook to compile detailed agricultural descriptions of the cotton-producing states (then including California), which were elaborated largely by the respective state geologists, and form parts of Vols. V. and VI. of the Census report of 1880. There are embraced within these volumes extended descriptions and maps of the several soil areas in these states, with 612 chemical and 12 physical analyses of soils, fully discussed in their bearings on agriculture. In 1892, the Department of Agriculture published, as Bulletin No. 3 of the Weather Bureau, a paper prepared by myself 'On the Relations of Soils to Climate,' in which among other things there is given a discussion of 779 analyses of soils of the United States, and of the nature, occurrence and reclamation of alkali lands.

Since that time many other states have entered upon similar lines of work; among them especially Minnesota, Texas, South Carolina, North Dakota, Washington, Idaho, Wyoming, Michigan and Rhode Island, in some cases with very elaborate cultural data and discussion. The entire number of soil analyses made in the United States thus far is probably in excess of 1,500.

In the face of all these facts, of which the records are easily accessible, especially at Washington, the Secretary of Agriculture has evidently been informed that practically no soil work worthy of the name had been done in this country until the present Bureau of Soils was organized by him; and has thus been induced to think it a matter of first necessity to send over two hundred scientists (*sic*) into the various states to fill these glaring deficiencies. Evidently it *has* been possible for the Bureau of Soils to find within the United States so large a body of qualified soil experts. The phenomenal rapidity with which these observers map the soil areas laid down in the reports of the bureau, seems to show that this feat has been accomplished. How well the work so done will stand the test of criticism from the scientific and practical standpoint remains to be seen.

E. W. HILGARD.
UNIVERSITY OF CALIFORNIA,
January 8, 1904.

SPECIAL ARTICLES.

PRELIMINARY REPORT ON THE CLASSIFICATION OF THE ROCKS OF THE WATKINS GLEN (30′) QUADRANGLE (U. S. GEOLOGICAL SURVEY).*

DURING the summer of 1903 Henry S. Williams assisted by Edward M. Kindle made the

* By permission of the Director of the U. S. Geological Survey.

survey of the Watkins Glen quadrangle preparatory to forming the folio map of this region. The results of the field work are now sufficiently well elaborated to permit of the following announcement:

The general similarity of the rocks of this whole region has made the use of paleontology in classifying them a necessity, and the resulting classification is primarily based upon paleontological evidence.

The rocks of the region have a general southerly dip, and the formations exposed on the surface are all Devonian. The lowest formation mapped is the Genesee black shale outcropping in the extreme northern part of the quadrangle in the bottom of the valleys of Cayuga and Seneca Lakes. Two major formational divisional planes are traceable across the quadrangle from east to west. These planes separate the Genesee from the following Portage, and the Portage from the succeeding Chemung. The paleontology is the chief ground for drawing these lines, but the lithology is in harmony with the other evidence. The Portage formation lying between these two planes attains a thickness of from 1,250 to 1,300 feet. Below it the Genesee is 120 to 150 feet thick. Above the Portage 1,225 feet of Chemung has been traced, but the top of the range of the Chemung fauna was not reached in the area surveyed.

No other planes offered sufficient continuity of evidence, either lithological or paleontological, for drawing the lines across the whole quadrangle. In the eastern half of the quadrangle the Portage is divisible, on clear paleontological evidence, into three members: the lower Portage, approximately 250 feet; the Ithaca, 400 feet; and the upper Portage, 600 feet thick. Faunally the same species characterize the lower and upper members of the Portage. The central member (the Ithaca) holds an entirely distinct fauna, homeotopic with that of the Hamilton and Chemung faunas lying below and above it. The lithological characters of the Ithaca are in general distinct from those of the Portage, but the difference is due rather to the dominance of the argillaceous shales in the Ithaca, over the flags and thin-bedded fissile, and generally dark-colored, shales which are more characteristic of the Portage, than to any uniform lithological character of either.

In the Seneca Lake valley the subdivision of the Portage into three members can not be made out sharply upon either lithologic or paleontologic evidence. A few scattered species of the Ithaca fauna appear within their proper zone, but the lower and upper Portage conditions dominate all through the sections for the whole 1,200 to 1,300 feet. The Portage fauna also recurs in some sections after the entrance of the Chemung fauna into the general region. The faunas of the Genesee and Portage are more closely related to each other biologically than either of them is to the Hamilton or to the Chemung fauna.

A recurrence of Hamilton species takes place in several zones; the more conspicuous cases are near the base of the Ithaca member, in Cascadilla Creek in Ithaca (as was stated in Bulletin 3 of the U. S. Geological Survey in 1884); near the base of the Chemung within the lowermost 100 feet of several sections in the quadrangle; and again in the upper Chemung about 600 feet above its base. This highest discovered *Tropidoleptus* zone is seen in quite a number of the sections in the southern half of the quadrangle.

In these recurrent faunas the more characteristic as well as dominant species are *Tropidoleptus carinatus, Rhipidomella vanuxemi, Cypricardella bellistriata;* also *Phacops rana* has been seen, and specimens of a *Spirifer* not to be distinguished from typical Hamilton forms of *Spirifer (mucronatus) pennatus.*

The lower zone of this fauna in the Chemung is below the first appearance of *Spirifer disjunctus,* but the upper zone is hundreds of feet above the first appearance of the typical *Spirifer disjunctus* fauna, and in several sections that fauna occurs abundantly both below and above it within a few feet of thickness of strata. The recurrent species are generally associated with a few of the common species of the normal fauna of the part of section in which they occur, but *Spirifer disjunctus* has not been discovered associated with them, though often occurring below as well as above, not very far distant.

These Hamilton recurrent zones rarely occupy over a couple of feet thickness. They are more conspicuous in the eastern than in the western parts of the quadrangle. In them the Hamilton species are often quite abundant, to the almost total exclusion of other species. Some slabs were obtained from actual outcrops on which nothing distinctively Chemung was apparent.

Near the top of the Chemung formation of the quadrangle, in the townships of the southern part of the Waverly quarter sheet are some distinct conglomerates with a fauna diverse from that of the Chemung which appears above as well as below them stratigraphically. The conglomerates are quite local, as shown by their non-appearance at the same altitude in some hills not far distant from those in which they were seen. In several parts of the quadrangle local limestone bands were seen, reaching a thickness of over a foot in some cases.

On the geological map of the state published by the State Geologist in 1894 a line is drawn between Hamilton and Portage, but as to which side of the Tully or Genesee no indication is given, and in the legend the Portage covers lower Chemung and Ithaca. In the revision of that map published in 1901 the outcrop of the Genesee is indicated, this is followed by the Portage in the western part of this region and over the quadrangle in part. In the eastern part the Ithaca rests upon the Genesee, thus making the Portage and Ithaca to occupy the same stratigraphic interval. Further east, in Chenango County and beyond, the lower half of this interval is indicated as Ithaca, and the upper half as Oneonta.

The upper line is drawn in the 1894 map between the Portage and Chemung; in the 1901 map between Portage and Chemung for the western half of the Watkins Glen quadrangle, and for the eastern half between the Ithaca and Chemung.

The result of the summer's work clears up both of these lines, showing the Ithaca to be a member of the Portage formation, as was first pointed out in Bulletin 3 of the U. S. Geological Survey in 1884, where also it was then indicated that the Ithaca is not the lower part of the Chemung (as was claimed by Hall in 1843) but is separated from its base by an upper part of the Portage, of several hundred, now shown to be approximately 600, feet of strata.

H. S. W.

CURRENT NOTES ON METEOROLOGY.

METEOROLOGICAL SOCIETY OF JAPAN.

Numbers 5 to 8 of the *Journal of the Meteorological Society of Japan*, recently received, show encouraging signs of the continued activity of that scientific body. The society was founded in 1882, and numbers now more than 260 members. The language used in the *Journal* (now in its twenty-second year) has hitherto been exclusively Japanese, but in the future it is intended to insert articles on Japanese meteorology, as well as on other scientific matters, in English, French and German. The *Journal* is published by the editorial committee of the society, with headquarters in the Central Meteorological Observatory in Tokio. The title pages of the separate issues of the *Journal* are printed in English, and the list of papers shows a considerable range of interesting topics, *e. g.*, 'Cloud Cap on Mt. Fuji,' 'On the Stationary Low Pressure Area in Formosa,' 'Storms in the North Pacific Ocean in April, 1903,' etc.

PROTECTION OF PEACH TREES FROM FROST.

In Bulletin 80 of the Agricultural Experiment Station of the Agricultural College of Colorado (1903) a description is given of the new method of protecting peach trees from frost by 'laying down.' This was first tried in the fall of 1896, at Cañon City, and has proved very successful. Early in November (at Cañon City) the trees are put into winter quarters. The earth is removed from a circle about four feet in diameter around the tree, and water is turned on. When the ground is saturated, the trees are worked back and forth, and are finally pushed over, with comparatively little injury to the roots. Then the limbs are brought together by a cord, and burlap, covered with earth, is put over them. In the spring, the covering is gradually

loosened, and later removed; then the trees are raised and propped up.

THE METEOROLOGY OF THE SÄNTIS.

HANN continues his valuable studies of mountain meteorology in a publication entitled 'Die Luftströmungen auf dem Gipfel des Säntis und ihre jährliche Periode' (*Sitzungsber. Wien Akad. Wiss., math. naturwiss. Kl.*, CXII., Abth. IIa, 1903, pp. 42), the Säntis being one of the most important mountain observatories of Europe. Fifteen years (1886–1900) of hourly observations of wind are discussed in detail, and compared with similar records at lower levels. In winter the mean wind direction is northeast; in summer nearly due west; in autumn (September-November) south to southeast. Southwest is the most frequent wind direction.

SOUTH AFRICAN METEOROLOGY.

SOUTH AFRICAN meteorology is beginning to make encouraging progress. Three recent papers, by J. R. Sutton, have been published in the *Transactions of the South African Philosophical Society*, Vol. XI., Part 4, and Vol. XIV., Parts 1 and 2, under the titles 'Some Pressure and Temperature Results for the Great Plateau of South Africa,' 'Results of some Experiments upon the Rate of Evaporation' (at Kimberley) and 'An Elementary Synopsis of the Diurnal Meteorological Conditions at Kimberley.' Mr. Sutton, who is already known for previous meteorological work at Kimberley, is in charge of the meteorological station of the De Beers Consolidated Mines.

R. DEC. WARD.

THE MISSOURI BOTANICAL GARDEN.

ADVANCE proofs of the fifteenth administrative reports on this institution, which have been received from its director, show customary growth and activity. In 1903 $27,272.48 was expended in maintaining the garden itself; $3,085.69 was spent on the herbarium; $4,239.85, on the library; $5,325.98, on the office; $967.68, on research; and $1,307.87 for the training and care of garden pupils. For improvements of the grounds and buildings $1,954.35 was spent; a fire-loss to the plant houses and collections led to the expenditure of $2,033.40; $481.17 was spent on the preparation and equipment of a phyto-chemical laboratory, and the cost of publications was $1,849.16.

The director's report combines a summary of progress for the past five years with the details for 1903, and the liberal use of coordinate curves makes the growth in all departments evident at a glance. An inventory at the end of the year showed that 11,357 distinct species or varieties were then in cultivation, an increase of 41.8 per cent. for the last five years. The visitors for the year numbered 79,039, and their distribution by months forms an interesting curve of seasonal out-of-door life in St. Louis. The herbarium now contains 465,205 specimens, valued at $69,780.75. Of these, 37,408 were incorporated last year, and the growth for the last five years amounts to 51.3 per cent. of the number reported at the end of 1898. The library contains 42,262 books and pamphlets in nearly equal numbers and 311,218 index cards, and is valued at $74,472.90. Its growth for the last five years is shown to be 27.7 per cent. The serial publications now received number 1,185, an increase of 27.4 per cent. over the number received five years ago.

The continued use of the equipment of the garden for research by its employees is noted, and the statement is made that "in every feasible way the library, herbarium and living collections are made useful to investigators, whether connected with the institution or not: when they can be used on the spot, every possible facility for their use is given visiting botanists: when this is not possible they are sent to trustworthy persons or institutions, when their safe return is guaranteed; and, except for specimens or books of especial value which could not be replaced in case of loss, or those in constant use, the garden has always stood ready to place its library and collections for a reasonable time at the disposal of botanical departments of colleges, or of capable investigators not having official connection with the centers of learning."

Small but satisfactory results are reported in the Shaw School of Botany, through which

in 1903 two candidates earned the master's degree, and one, the doctor's degree, in Washington University, in which one candidate for the former and three for the latter are now enrolled with majors in botany.

Details are given of the workings of the school of gardening, the organization of the office staff, and the gardening operations for the past year; and the report closes with an account of the special testamentary provisions of the founder of the garden, among them the recent banquet of the trustees, at which several hundred of the scientific men of the country were guests during the last convocation week.

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*THE DEPARTMENT OF ECONOMICS AND SOCIOLOGY OF THE CARNEGIE INSTITUTION.**

THE Department of Economics and Sociology of the Carnegie Institution was by the action of the executive committee placed wholly in charge of Carroll D. Wright, commissioner of labor. The first great work to which this department is to address itself is the preparation of an economic history of the United States, embracing eleven subjects:

(1) *Population and Immigration.*—To this branch Commissioner Wright has assigned Professor Walter Willcox, of Cornell University. Professor Willcox will not treat his subject merely on its statistical side, but will deal broadly with such questions as the influence of the movement of population and immigration on the economic development of the country, one of the principal features to be considered being the routes that immigration has taken at various stages.

(2) *Agriculture and Forestry,* including public land and irrigation interests. To this work Mr. Wright has assigned President Kenyon L. Butterfield, of the Rhode Island Mechanical and Agricultural College.

(3) *Mining.*—This is committed to Edward W. Parker, of the Geological Survey.

(4) *Manufactures.*—This subject will be handled by S. N. D. North, director of the United States Census.

(5) *Transportation* will be considered by Dr. W. Z. Ripley, of Harvard University.

(6) *Domestic and Foreign Commerce,* including fisheries, is in the hands of Professor Emory R. Johnson, of Pennsylvania University.

(7) *Money and Banking* will be considered by Dr. David R. Dewey, of the Massachusetts Institute of Technology.

(8) *The Labor Movement* has been reserved by Commissioner Wright for himself.

(9) *Industrial Organization* is the subject assigned to Professor J. W. Jenks, of Cornell University.

(10) *Social Legislation* will be treated by Professor Henry W. Farnam, of Yale University. He will include in his study provident institutions, poor laws, and kindred topics.

(11) *Federal and State Finance,* including taxation. The authorship of this treatise the department is not yet ready to announce.

The collaborators will utilize all available material that has been published mostly in fragmentary ways, as well as all material that can be secured from original sources by special research. For this purpose, graduate students and others interested in special lines will be employed. It is impossible to state how long it will take to finish the work, but it will be pushed with all the force compatible with accuracy and completeness. The allotment of money for the first year is $30,000.

As has been said, Commissioner Wright has been put in charge of the entire enterprise, and during the present year he will have the direction of the work of the staff from the office of his department at Washington. After this year, when he will have retired from the Department of Labor, he will direct the work from his new seat of activity in Worcester, Mass.

* From the New York *Evening Post.*

SCIENTIFIC NOTES AND NEWS.

THE twenty-fifth anniversary of the conferring of the doctorate on Dr. Wilhelm Ostwald was celebrated at Leipzig on December 19. A *Festschrift* has been prepared by his pupils.

PROFESSOR F. W. PUTNAM has resigned his position in the American Museum of Natural History which he has held for nearly ten

years. He has been granted leave of absence from Harvard University for three months this winter, and will spend this time in directing the work of the Department of Anthropology and the Anthropological Museum of the University of California. Professor Putnam has been appointed chairman of the Department of Anthropology in the International Congress of Arts and Science at the St. Louis Exposition.

PROFESSOR S. P. LANGLEY has been appointed by the International Meteorological Committee a member of the commission (mentioned on page 658 of Vol. XVIII.) to consider the study of the relations of solar physics to meteorology.

THE board of visitors to the Naval Academy includes President Henry S. Pritchett, of the Massachusetts Institute of Technology, and Professor Ira N. Hollis, of Harvard University.

PROFESSOR F. E. LLOYD, of Teachers College, Columbia University, has received a grant from the Botanical Society of America, to carry on researches at the Desert Botanical Laboratory of the Carnegie Institution at Tucson, Arizona.

DR. NICHOLAS SENN sailed from San Francisco on January 7 for Tahiti, where he will join a commission appointed by the French government to investigate the diseases of the island.

DRS. E. L. TYSER and W. R. Brinckerhoff, of the Harvard Medical School, have been sent on a commission to the Philippines to study smallpox and other contagious diseases.

MR. WILLIAM BARNUM, formerly of the Fish Commission, has been appointed chief clerk of the Carnegie Institution.

PROFESSOR F. H. KING, of the Bureau of Soils, U. S. Department of Agriculture, has resigned. He has been connected with the Bureau of Soils since November, 1901, in charge of the work in soil management.

MR. CHARLES HENRY THOMPSON, assistant in botany at Stanford University, has been appointed to take charge of the Department of Succulent Plants at the Missouri Botanical Garden.

DR. WILLIAM OSLER, professor of medicine at the Johns Hopkins University, will give this year the Ingersoll lecture at Harvard University, his subject being 'Science and Immortality.'

THE chapter of the Sigma Xi at the Ohio State University is giving a series of lectures this winter. The first was by Professor A. D. Cole on 'Why Light is believed to be an Electrical Phenomenon'; the second lecture was delivered January 25 by Dr. Victor C. Vaughan, of the University of Michigan, on 'Immunity from Disease'; the third lecture will be given by Professor F. L. Landacre.

PROFESSOR W. B. SCOTT, Blair professor of paleontology at Princeton University, has begun a course of sixteen lectures at the Wagner Institute, Philadelphia.

THE death is announced of Dr. Georg von reception on January 13 to celebrate the return of some of the members of the *Gauss* South Polar Expedition. Count Posadowsky, minister of the interior, delivered an address of welcome. Dr. von Drygalski then gave a lecture recounting his experiences, and was afterwards presented with a gold medal.

THE prize of the Swedish Medical Association has been awarded to Professor M. G. Blix, of Stockholm, for his work on the temperature of the muscles.

THE death is announced of Dr. Georg von Liebig, docent in climatology at the University of Munich. He was a son of Justus von Liebig.

A CIVIL service examination will be held on March 2 and 3 for the position of miscellaneous computer of the U. S. Naval Observatory.

THE sixth International Congress of Physiology will be held at Brussels from August 30 to September 3. Communications should be addressed to Dr. Slosse, Institute Solvay, Parc Leopold, Brussels, Belgium.

GOVERNOR ODELL has signed a bill authorizing the consolidation of the New York State Medical Society and the New York State Medical Association.

The Madrid correspondent of the London *Times* writes that in anticipation of the total eclipse of the sun of August, 1905, the papers are beginning to urge the government to include in next year's estimates an item providing for a scientific mission of Spanish astronomers to be sent abroad, in order to study in foreign observatories the latest methods of investigating the phenomenon. For the eclipse of 1900 the Cortes voted 190,000 pesetas, but the measure was taken so late that the money was spent at a loss. It may be mentioned that the zone of about 200 kilometers covered by the eclipse of 1905 traverses Spain from Galicia and Asturias to Valencia and Castellon. The northern coast between Coruña and San Vicente de la Barquera and the eastern from Valencia to the Gulf of San Jorge will be included in the zone of total obscurity. Observers at Ferrol, Lugo, Oviédo, Gijon, Léon, Palencia, Burgos, Soria, Teruel and Saragossa will have some four minutes in which to make their notes. Madrid lies to the south of the zone of total eclipse.

UNIVERSITY AND EDUCATIONAL NEWS.

It was announced at the meeting of the trustees of the Catholic University of America on January 28 that the annual collection authorized for the university will amount to $100,000, and that this sum might be expected in each of the next nine years.

Teachers College, Columbia University, has received a gift of land valued at $50,000 from the heirs of William Earl Dodge.

Mr. Henry Phipps has given $20,000 to the Johns Hopkins Hospital to establish a clinic for consumptives.

Harvard University has received $6,000 for scholarships from the estate of Daniel A. Buckley.

The finance committee of Liverpool has recommended a grant of $50,000 to Liverpool University for the current year.

A fellowship in dermatology has been endowed at Liverpool University by Dr. Stopford Taylor.

The Association of American Universities will hold its next meeting at Yale University on February 18, 19 and 20. The program includes a discussion of uniformity of university statistics opened by Dr. Rudolf Tombo, Jr., of Columbia University; a discussion of the question 'Are the degrees of Bachelor of Science, Bachelor of Philosophy and Bachelor of Letters to be preserved or to be merged in the degree of Bachelor of Arts?' by Professor Richard Hudson, of the University of Michigan and by Professor Paul Shorey, of the University of Chicago, and a discussion on the administration, financial support and circulation of university publications, including doctor's dissertations and scientific journals and the general transaction of the business of the university, by President Ira Remsen, of the Johns Hopkins University, and Professor Charles Montague Bakewell, of the University of California. Papers will also be presented on the actual and the proper lines of distinction between college and university work by President Hadley of Yale University, and President Jordan of Stanford University. The admission of Brown University and New York University as members of the association will be considered.

Dr. Charles S. Howe will be inaugurated president of the Case School of Applied Science on May 11.

Mr. W. D. Gibbs, director of the Agricultural Experiment Station of the University of Texas, has been appointed president of the New Hampshire College of Agriculture and the Mechanic Arts.

Dr. H. D. Bergey has been appointed assistant professor of bacteriology at the University of Pennsylvania; Drs. Leo Loeb, William T. Cummins and Henry R. Alburger have been appointed assistant demonstrators of pathology; Dr. H. C. Richards has been appointed assistant professor of physics.

Dr. Oskar Eckstein, instructor in organic chemistry in Tufts College, has been appointed lecturer in chemistry in the University of Chicago.

Mr. Christopher Royce has been appointed instructor in mathematics at New York University on account of the illness of Professor Pomeroy Ladue.